PULMONARY

CONSUMPTION

—

ARTHUR LATHAM

THIRD EDITION

PULMONARY CONSUMPTION

THE

DIAGNOSIS AND MODERN TREATMENT

OF

PULMONARY CONSUMPTION

WITH SPECIAL REFERENCE TO

The Early Recognition and the Permanent Arrest of the Disease

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PREFACE

TO

THE THIRD EDITION

THE scope of this little book remains the same, and I have again refrained from exhaustive reference to the pathological anatomy of consumption. A number of additions have been made to various sections, and new sections have been inserted on such subjects as the value of the opsonic index in diagnosis and treatment, the use of Koch's new tuberculin in treatment, and Dr. Paterson's interesting observations on the value of manual labour at Frimley Sanatorium. I have to thank Dr. Charles Slater and Dr. Harold Spitta for much assistance in bacteriological questions.

A. L.

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PULMONARY CONSUMPTION

CHAPTER I

THE VARIETIES OF PULMONARY CONSUMPTION

THE clinical picture presented by tuberculosis of the lungs differs widely in individual cases, and it is this fact which has caused some of the older authors on the subject to discuss as many as fifteen or more distinct varieties of consumption. Fortunately, however, for the student of to-day, the complicated classifications which previously held good have gradually given way to simpler ones. The changes brought about by the tubercle bacilli and their products, when they gain entrance into the lung tissues, are the result of inflammation; and although the changes *Pathological* produced are usually chronic, and have certain peculi- *considera-* arities, such as the tendency to caseation, Koch's bacilli *tions.* cause essentially the same sequence of inflammatory phenomena as other irritants. In every form of inflammation we may have either resolution, destructive changes —such as necrosis or ulceration—or efforts towards repair, such as the growth of fibrous tissue or the deposition of calcium salts. Pulmonary tuberculosis is no exception to this rule. Koch's bacilli may be destroyed and leave no trace, or they may cause destructive changes and lead to

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softening, or they may excite the growth of fibrous tissue —that is, they may bring into play the defensive reaction of the tissue cells. These various changes seldom occur singly; in other words, it is unusual to find on examining the body of any person who has died of consumption only one result of the inflammatory processes. In some cases one phase, such as caseation, predominates; in another we find fibrosis as the characteristic feature; but, practically speaking, all cases show, in one or other portion of the lungs, several of the various direct consequences which may be brought about by the irritating properties of the bacilli or their products.

These considerations show how readily a complex classification of the disease might arise, but they suggest at the same time that the apparent anomalies met with

Results following the entrance of tubercle bacilli into the lungs.

in practice may be brought under a few heads. Tubercle bacilli, when they enter the lungs by the blood-stream, probably always cause a miliary tuberculosis; but when they enter the lungs in any other manner they give rise, in the majority of cases, to a broncho-pneumonia. This broncho-pneumonia may be discrete and localized, or it may be diffuse or even confluent; it may rapidly be followed by caseation or definite ulceration, or it may be replaced by fibrous tissue. More rarely the bacilli give rise to a definite lobar pneumonia.

It is not my intention in this place to describe the pathology of pulmonary tuberculosis in detail, but I have said sufficient to show that no elaborate classification of varieties is required. As in all other inflammatory conditions, we must consider the disease under two main headings—viz., acute and chronic. The chief varieties of

the chronic forms are (1) the fibro-caseous or ordinary Classification of varieties. form, and (2) the fibroid form. Among the acute forms we may recognise (1) the broncho-pneumonic form, (2) the lobar-pneumonic form, and (3) acute miliary tuberculosis. In addition we have another group, which it is difficult to classify, and which includes cases of both acute and chronic disease. This group embraces various irregular forms, to which I shall refer in greater detail in connection with the more chronic varieties. It is, however, important to remember that in any one case we may find many or even all of these subdivisions exemplified ; that it is rare to find, for instance, a pure example of the fibroid form ; and that at any moment disease of one particular variety may undergo certain changes, and so may come to represent a different class ; thus, fibro-caseous disease not infrequently ends as acute miliary tuberculosis.

CHAPTER II

THE DIAGNOSIS OF THE CHRONIC FORMS OF PULMONARY CONSUMPTION

I. THE FIBRO-CASEOUS FORM.

(a) *Diagnosis in the Early Stages.*

IN reviewing the difficulties to be met with in diagnosing the more common forms of the disease it will be convenient to consider the chronic forms first, as the fibro-caseous variety is the one most often found in persons suffering from pulmonary tuberculosis. Many difficulties in diagnosis are met with in the early stages of the disease in this form, for the clinical indications of the pathological changes may not be well marked. It is unfortunate that this is so, for the early diagnosis of pulmonary consumption is a question of supreme importance, perhaps the most important which the physician has to face. At least one person out of ten dies in this country from the disease, and a large proportion of those who die from other diseases are afflicted with tuberculosis in one or other of its forms. If a correct diagnosis is made in the early stages of consumption we can bring about complete arrest of the tuberculous processes in the majority of instances, whilst in the later stages our efforts must often be largely palliative. I am

Importance of an early diagnosis.

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not, I think, making too strong a statement when I assert that the majority of persons dying from consumption, in whom the disease is undetected in the early stages, die within three or four years from the onset of the disease.

On what grounds, then, are we justified in making a positive diagnosis of early pulmonary consumption? In many cases the difficulties are not great. We are enabled to make a positive diagnosis when—

1. Tubercle bacilli are present in the expectoration or saliva, provided that no source for these is to be found in the mouth or upper air-passages.

2. Hæmoptysis, even to such a small extent as a tea-spoonful, is associated with suspicious physical signs or symptoms, and a careful examination of the patient reveals no evidence that the blood comes from the upper air-passages, or that it is dependent upon some other lesion than tuberculosis.

3. We find diminished resonance and increased resistance to the finger, associated with the presence of *persistent* crepitations or fine rales in those situations in which tuberculosis usually starts—that is to say, in the apices of the lungs, more especially towards their posterior aspect.

It will be convenient if I discuss these headings in greater detail at once.

1. WHEN TUBERCLE BACILLI ARE PRESENT IN THE EXPECTORATION OR SALIVA, NO MATTER WHAT SYMPTOMS MAY BE PRESENT, NO MATTER WHAT PHYSICAL SIGNS MAY BE FOUND, WE MUST MAKE A POSITIVE DIAGNOSIS OF PULMONARY CONSUMPTION.

The only exception to this rule is primary tuberculosis of

the mouth or of portions of the upper air-passages, such as the tonsils or larynx, conditions which are so rare that for practical purposes they may be neglected.

Case.

As an example of this group I would give the following illustration : A young medical student on commencing his clinical work examined, more for practice than anything else, his own saliva to see what micro-organisms were present. He was considerably alarmed to find tubercle bacilli in small numbers on two occasions. On examination of his chest no physical signs of disease could be detected. He occasionally spat up a little mucus in the morning, and this I examined for tubercle bacilli. A positive result was obtained, and consequently a definite diagnosis of tuberculosis was given. The patient ordered his life accordingly, with the result that he is now, some eight years afterwards, in good health, and the only signs of tuberculous mischief are slight dulness and impaired breath-sounds at the left apex— that is to say, the signs of a healed tuberculous lesion.

Constantly recurring attacks of fever.

Again, every medical man sees patients who are apparently in good health, but who complain of repeated attacks of what they term 'influenza,' or of a great tendency to 'catch cold.' We may be consulted by patients with a history of some previous lung trouble and subsequent wasting, or by patients with a tuberculous family history who are themselves anæmic and troubled by a persistent dry cough. In many of these cases it is impossible to make a positive diagnosis from the physical signs. Our suspicions are aroused chiefly because there is a history of recurring attacks of fever, whatever

term, influenza or other, may be used to describe this condition. In such cases it is our duty to carefully examine the sputum for tubercle bacilli, and, if these micro-organisms are found, to give a positive diagnosis.

Some few years ago a personal friend of my own, under Case. the care of Dr. H. Menzies, although in apparently good health, had several slight attacks of fever. There was no family history of tuberculosis, and an examination of the chest revealed no physical signs of any disease. Some sputum, which was expectorated in small quantities during one of these attacks, was examined. Tubercle bacilli were found, and the patient was persuaded, with some difficulty, to give up his work, and to devote his attention for a time entirely to his health. His condition at the present time is good, and the disease is practically arrested. It is, however, interesting to notice that the physical signs which are now to be found confirm the original diagnosis and emphasize the importance that should be paid to the presence of tubercle bacilli.

In such cases it is our duty to examine the sputum for tubercle bacilli, and we must not be content with one examination if the result is negative, but must make repeated attempts to find the bacilli, the number of Importance examinations varying with the strength of our suspicions. of making repeated For example, I remember examining, when working in examinations the Bacteriological Laboratory at Cambridge, the sputum for the bacilli. of a patient in whom Dr. P. W. Latham strongly suspected the presence of tuberculosis. I examined this sputum on eight occasions, making six preparations on each occasion, and found no tubercle bacilli; on making

however, a ninth examination I was able to demonstrate the presence of a limited number of bacilli, and so to establish a positive diagnosis.

If bacilli are found, the diagnosis is certain, and the patient must follow the lines of treatment laid down in subsequent chapters. In the great majority of those cases in which the physical signs are slight we may confidently assure our patients that, if they are able to carry out the necessary treatment in all its details, they will throw off the disease to all intents and purposes.

2. A Positive Diagnosis of Pulmonary Consumption should be made when Hæmoptysis, even to such a Small Extent as a Teaspoonful, is associated with Suspicious Physical Signs or Symptoms, and a Careful Examination reveals no Evidence that the Blood comes from the Upper Air-Passages or is dependent upon some other Disease than Tuberculosis.

Some authors go further than this and say that we should make a positive diagnosis of consumption in every case in which hæmoptysis occurs and no cause for it can be found. It is probable that if we adopted this attitude, our percentage of error would be small, and at the same time patients in whom this symptom was really due to tuberculosis would not run the risk of treatment being postponed until the physical signs of their disease were advanced and the chance of their complete recovery commensurately diminished. There can, however, be no doubt that people do suffer from hæmoptysis without presenting any signs of disease, and without subsequently

Hæmoptysis without definite signs of disease is probably due to consumption.

developing tuberculosis. Ware states that out of 386 cases of hæmoptysis seen in private practice 62 recovered, and did not at any time develop tuberculosis. Osler has recorded three examples of hæmoptysis occurring in students, who fifteen and more years later were in perfect health. My own experience is that an overwhelming number of those patients who suffer from hæmoptysis without any physical signs or symptoms to account for its presence, subsequently develop well-marked physical signs of tuberculosis. A large proportion of patients in whom hæmoptysis occurs in the early stages of tuberculosis present no physical signs or symptoms. In a certain number of these the lesion may undergo a favourable course, and may be healed before it gives rise to changes sufficiently definite for detection, but in the great majority of instances well-marked signs of disease are developed eventually—it may be as long as two years afterwards—unless an appropriate course of treatment is adopted. The disease in these instances is present at the time of the hæmoptysis, but, so far as definite signs go, is latent for a longer or shorter period. It is prac- *Tuberculosis ab hæmoptoë.* tically never due to the tubercle bacilli obtaining an entrance at the time of the hæmorrhage—that is, tuberculosis does not, as was once thought, arise *ab hæmoptoë.* Therefore when hæmoptysis occurs, and no cause for its occurrence can be found, it should be regarded as giving presumptive evidence that tuberculosis is present. When in addition to the hæmoptysis definite physical signs of disease are found, or tubercle bacilli are detected, a positive diagnosis should always be made. In my opinion a positive diagnosis should also be given when,

in addition to the bleeding, suspicious physical signs or symptoms, such as wasting or recurring attacks of slight fever, are present, or when there is a history of probable infection.

A woman of thirty-five years of age came to my out-patient department at the Brompton Hospital with a history of hæmoptysis to the amount of a tablespoonful on two occasions. Her husband and five children had died from consumption during the previous three years. I examined her carefully, but could detect no sign of disease nor any cause for the bleeding. In spite of this I made a positive diagnosis of tuberculosis on the association of the blood-spitting and the exposure to infection.

Naturally, when we make a diagnosis mainly on the occurrence of hæmoptysis, we must first exclude the other causes of hæmoptysis which are discussed on p. 13. If we find no such cause, we must insist on a rigorous course of treatment at once, otherwise our patients lose their best opportunity of getting well, and may come back later with well-marked signs of consumption.

When hæmoptysis is the only symptom and no trace of disease can be found, we should view the case with suspicion and endeavour to settle the question whether tuberculosis is present or not by using tuberculin or, according to some authorities, by means of the opsonic index (p. 26).

When we are consulted by a patient who is said to have been spitting up blood, we must first of all make certain that the case is one of hæmoptysis and not one of hæmatemesis, for, in the nature of things, both the patient and his friends are frequently so alarmed at this

symptom that their accounts are apt to be misleading. If we are satisfied that the blood really has been spat up, we must endeavour, by a process of exclusion, to ascertain the pathological cause. In the majority of instances there is no question as to the origin of the blood, but difficulties occasionally arise, more especially if the patient is not seen by a medical man during the attack. We may be able to make a diagnosis immediately from the physical signs, but hæmorrhage not infrequently occurs from the lungs or stomach without any marked evidence of pulmonary, gastric, or hepatic disorder. When such definite evidence cannot be found, a correct conclusion may usually be formed if we investigate the case on the following lines :

(*a*) If the blood suddenly makes its appearance in the mouth, without the act of coughing or vomiting, or if it is definitely coughed up, we may exclude hæmatemesis, more especially if there has been a previous sensation of tickling in the throat. If, however, the patient vomits up the blood, and especially if, previous to this, he experiences a feeling of giddiness or faintness, the probability is that the blood comes from the stomach. We must, however, remember that blood from the upper air-passages, and occasionally from the lungs, may first be swallowed, especially in children, and then be vomited. Further, the account given by the patient or his friends may sometimes be inaccurate, as the coughing up of blood is sometimes followed by vomiting, and the patient lays undue stress on the latter symptom.

The way in which the blood is brought up.

(*b*) If the blood is intimately mixed with air and froth, if it is bright red in colour, alkaline in reaction, and gives

The character of the blood.

rise to no unpleasant taste in the mouth, or nothing more than a metallic taste, we are dealing with a case of hæmoptysis. The clotting of the blood in cases of hæmoptysis is rarely so great as in hæmatemesis, whilst a more detailed investigation will often reveal the presence of muco-pus, alveolar cells, or, in a certain number of instances, tubercle bacilli. If the blood, on the other hand, is not mixed with air, is dark in colour or resembles coffee-grounds in appearance, or if it is mixed with particles of food and has an acid reaction, we are dealing with a case of hæmorrhage from the stomach, provided that we can make certain that the blood has not been previously swallowed.

Previous history of the patient.   (*c*) If we are still in doubt, the previous history of the patient is often useful. If there is a history of gastric pain previous to the attack, or of symptoms pointing to cirrhosis of the liver or to splenic congestion, we must lean to a diagnosis of hæmatemesis. If, on the other hand, there is no such history, but there is the history of a cough, or of pulmonary disease, we may suspect a thoracic origin.

        (*d*) If we are unable to arrive at a definite diagnosis on the results of these investigations, we may often do so by Subsequent symptoms. watching the subsequent course of the patient's symptoms. If the cough persists, and if the sputum is tinged with blood, or, as is frequently the case, contains small clots, there is no difficulty in the diagnosis. If, on the other hand, we suspect gastric disease, and the patient vomits subsequently, or develops symptoms of gastritis, or if he passes tarry stools for a few days, we may exclude hæmoptysis in the great majority of cases.

When we have excluded hæmatemesis in this way, we must endeavour to determine the cause of the hæmoptysis. This symptom is met with under many conditions other than pulmonary tuberculosis. Consequently, in investigating a case of hæmoptysis we must make certain that none of the common causes for the occurrence of the blood-spitting are present, before we conclude that it is due to pulmonary tuberculosis without any physical signs.

Causes of Hæmoptysis.—(*a*) Pulmonary tuberculosis.

(*b*) Epistaxis; wounds, ulcerations or ruptured veins in the mouth, pharynx, œsophagus, and upper air-passages.

(*c*) Diseases of the lungs other than tuberculosis. This symptom occurs commonly in the early stages of pneumonia, and in the later stages of cancer; more rarely in bronchiectasis, bronchitis, emphysema, pleurisy, abscess or gangrene, or in ulceration of the bronchi. It may, indeed, occur to a slight extent in nearly any form of pulmonary disease.

(*d*) Cardiac disease. More especially in cases of mitral stenosis and mitral deficiency, either from mere congestion, or, more frequently, owing to infarction.

Amongst less common causes may be mentioned:

(*e*) Aneurism of the aorta, or of the large vessels, either by definite rupture into the bronchi, trachea, or upper air-passages, or by gradual oozing.

(*f*) Arthritis in persons of advanced middle age. In these cases the hæmorrhage is probably due to degeneration of the vessels.

(*g*) Blood conditions, such as the hæmorrhagic fevers, purpura hæmorrhagica, hæmophilia, pernicious anæmia.

(*h*) Vicarious menstruation.

If we find definite evidence of any of the above causes we can make our diagnosis. If, however, a careful examination yields no evidence of the presence of any of the above conditions, and if there are any suspicious symptoms or physical signs present, we must be prepared to accept the responsibility of making a dogmatic diagnosis of pulmonary tuberculosis which so far has given rise to no definite physical signs. We must be careful not to overlook some trivial cause, such, for example, as Dr. William Murray, with characteristic courage, describes in the following extract from his book : ' A gentleman, whose name is now a household word throughout the world, called on me in great alarm on account of an attack of blood-spitting. I saw a good deal of blood upon his handkerchief, and on examining his chest I heard, or thought I heard, rough breathing and fine crepitation over the left apex. I told him this and treated him accordingly. On going to his shop he . . . looked into his mouth and discovered that the bleeding was from a spongy gum which he had doubtless lacerated with his tooth-brush. I need not say that he lost confidence in me and I lost my patient.'

Trivial causes must not be overlooked.

Some persons who are in the habit of sucking their gums, occasionally are alarmed by the presence of blood in their mouths. Hæmoptysis of this form nearly always takes place in the early morning, and is readily diagnosed. Malingerers sometimes endeavour to deceive us by artificial hæmoptysis.

Spurious hæmoptysis.

The following examples may be given as illustrations of my practice in cases in which hæmoptysis is the main symptom :

(1) A lady eight years ago spat up on three occasions a teaspoonful of blood. I examined her carefully at the time, to see if the blood had any possible source except the lungs, but found none. There was no family history of tuberculosis, and the patient had had no previous illness. The only physical sign of disease which I could detect was a slight but persistent pleuritic creak heard over the left supraspinous fossa. I endeavoured to convince this patient of the importance of looking after her health for a somewhat prolonged period of time, but did not succeed. The physical signs made very slow progress until December, 1900, when she had a sharp attack of bronchitis. In consequence of this the tuberculous mischief extended a little. Sir R. Douglas Powell and I were then able to convince the patient that she was really ill. She went, on our advice, to a sanatorium, where she gained nearly 2 stone in weight, whilst the physical signs now present are those of arrested disease. If she had been willing to undergo treatment at an earlier stage she would have been saved some years of ill-health.

(2) A gentleman working for the Indian Civil Service examination, whom I saw with Mr. R. C. Gayer in Kensington, was seized with profuse hæmoptysis. There was a strong family history of tuberculosis, but no physical signs save a few crepitations beneath the right clavicle. We thought that these crepitations might possibly be due to the recent hæmoptysis, but they persisted for some considerable time, and were due to tuberculous disease. There was no other cause for the bleeding, so Mr. Gayer and I took the responsibility of advising this patient to spend the winter at St. Moritz, although to do

so involved an entire change of his plans, and, indeed, of his life. At St. Moritz he gained over a stone in weight, and when I saw him some years later he looked the picture of health, whilst the only evidence of disease that we could find was a deficient entry of air, with very slight dulness over the right clavicle.

(3) In a case which I saw with Mr. J. S. Selby at Waddesdon, there was hæmoptysis so profuse that the patient became almost pulseless, but there was no physical sign of disease or family history of tuberculosis, and no bacilli were present in the sputum. The patient, however, was so tuberculous in aspect that I advised him to devote at least a year to his health, although this procedure was highly inconvenient. I have since heard from Mr. Selby that the great improvement which has followed in this case more than justified our advice.

3. FOR ALL PRACTICAL PURPOSES WE MUST DIAGNOSE PULMONARY TUBERCULOSIS WHEN WE FIND DIMINISHED RESONANCE AND INCREASED RESISTANCE TO THE FINGER ASSOCIATED WITH THE PRESENCE OF PERSISTENT CREPITATIONS OR FINE RALES IN THOSE SITUATIONS IN WHICH TUBERCULOSIS USUALLY BEGINS—THAT IS TO SAY, IN THE APICES OF THE LUNGS, MORE ESPECIALLY TOWARDS THEIR POSTERIOR ASPECT.

Association and situation of these signs important.

If there is no diminished resonance we cannot make a positive diagnosis; for example, we cannot arrive at a definite conclusion in those cases in which there is no alteration of the percussion note, but in which such physical signs as diminished breath-sounds and fine rales are present, associated perhaps with slight fever. These rales,

sometimes, eventually clear up, and are in such cases probably due to local catarrh of the smaller tubes. Nor, again, can we make so positive a diagnosis, in the absence of tubercle bacilli from the sputum, when there is dulness with adventitious sounds in some other situation than the apex of the lung. In a small number of instances we may find the first physical evidence of pulmonary tuberculosis either at the bases of the lungs, or in the neighbourhood of the nipples, or in the axillary regions, but in these situations other conditions may occasionally give rise to the same physical signs as those of early tuberculosis, and we are not justified—at any rate, for some little time—in making as positive a diagnosis as we are when the apices are affected.

The presence of *persistent* crepitations, in conjunction with the other physical signs, is the important point—the presence, that is, of crepitations over the same area on two or more occasions, which do not disappear when the patient coughs. It is not uncommon to see patients, especially children, in whom some pulmonary lesion has been followed by a localized emphysema at one or other apex, together with the formation of adhesions. In such cases we may have retraction of the supraclavicular or supraspinous fossa, with impaired resonance and diminished entry of air. These cases simulate tuberculosis very closely, but any adventitious sounds which may be present clear up when the patient coughs or breathes deeply—in other words, they are not persistent. It is of great importance that the patient should thoroughly expand his chest during the physical examination. It is also essential that during auscultation of any suspected

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area the patient should give a sharp cough. If crepitations are present, this cough may clear them up, and so save a serious error in diagnosis. If no crepitations are heard during ordinary respiration, a sharp cough may be accompanied by some. These post-tussic crepitations are of great value in the diagnosis of consumption.

An example of the above signs, with persistent crepitations, was furnished by a patient whom I saw in 1900, at Sawston, with Mr. F. Edwards. This lady was well nourished, and there was no family history of tuberculosis or history of exposure to infection. She had enjoyed previous good health, save that she had been troubled for a few months by a dry hacking cough. There was no loss of weight and no rise of temperature. The sputum had been examined on several occasions, but no tubercle bacilli were found. On making a physical examination we detected slightly diminished resonance and increased resistance to the finger, together with feeble respiration and a few crackles at the end of inspiration above the left clavicle, and, to a less extent, in the left supraspinous fossa. The other portions of the lungs were healthy. I made a positive diagnosis of tuberculosis, notwithstanding the absence of tubercle bacilli, and the patient regulated her life in accordance with that opinion. Two years after she was well, the only signs present being slight dulness and diminished breath-sounds at the left apex, together with definite, though slight, contraction in that position— signs, that is, of a healed tuberculous lesion.

In all suspicious cases of this kind we should carefully search for evidence of tuberculosis elsewhere in the body. If we find tuberculosis of a bone or other portion of the

body, our doubts are strengthened, and in the great majority of cases we are more than justified in explaining the suspicious signs as being due to the spread of tuberculous infection.

For instance, I was consulted by a gentleman who ^{Case.} had previously had one of his knee-joints excised for tuberculous disease, and in whom Mr. Allingham had recently opened an abscess in connection with the spinal column. When I saw this patient he was complaining of cough and a little pain in the right axilla. On examination, I found a few scattered crackles in the right axilla and at the right base. There were no tubercle bacilli in the sputum, but the physical signs persisted. This patient, on our advice, went to live in New Zealand for two years. On the voyage out his cough became worse, and he expectorated a large quantity of nummular sputum. I have lately examined him, and found the signs of old pleurisy in the right axilla. He has increased in weight, and is now in better health than he has been for many years.

So far, then, there is no great difficulty in arriving at a positive and accurate diagnosis. When we meet with such signs and symptoms as I have mentioned above, it is imperative that we should treat the patient for pulmonary tuberculosis on the lines described in subsequent chapters.

There is a group of cases, more numerous than has been supposed, in which we cannot give so positive a diagnosis, but in which the presence of consumption is probable—namely, cases in which there is a previous history of pleurisy.

A previous attack of pleurisy, it may be some years before, is of much importance as pointing to the probability of

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the presence of tuberculosis of the lungs at a subsequent date. In 16 per cent. of the cases of consumption admitted to the Brompton Hospital there is history of previous pleurisy. Many observers who have followed the history of persons attacked by pleurisy have found that consumption develops in a large percentage of cases, in some series even in 45 per cent. of cases. Landouzy considers that 75 per cent. of all cases of acute pleurisy are tuberculous in origin.

In view of these observations, I think it is a wise course to recommend patients suffering from doubtful physical signs or symptoms, in whom there is a history of previous pleurisy, to undergo open-air treatment for a time.

The importance of a history of former pleurisy.

As the result of my own experience, I am in the habit of regarding an attack of pleurisy which is not shown at the time to be due to some other cause, such as pneumococcic infection, as being tuberculous in origin. This is especially the case in young adult patients. If such cases are treated on open-air lines for a month or two immediately the pleuritic attack has subsided, the risk of subsequent lung trouble is slight.

Conditions where an early diagnosis is difficult.

Unfortunately, however, there is a large group of cases of early consumption in which the symptoms or physical signs do not warrant a positive opinion. Patients, especially young people, consult us on account of progressive wasting, when there is no malignant disease or diabetes to account for this symptom; or patients complain of general ill-health, associated with pains in the chest, or of frequent attacks of so-called influenza or feverish cold. Others may consult us because they are suffering from slight cough, anæmia, and possibly feeble

Suspicious symptoms.

digestion; or, again, we see individuals who give a history of previous pneumonia, or some other lung trouble, with subsequent debility and ill-health. In all such instances there may be in addition a history suggesting tuberculosis, and yet on examination we may find no physical signs of disease and no tubercle bacilli in the sputum.

On the other hand, we may find certain indefinite physical signs. We may find, amongst other things, definite myotatic irritability; commencing depression or flattening in the region of one or other clavicle or supraspinous fossa, or diminished freedom of costal movement; slight increase of the vocal and tactile vibration; slight diminution in the clearness and duration of the percussion note, or slight increase in the resistance to the fingers; diminution of the respiratory murmurs, prolongation and slightly higher pitch of the inspiratory and, more especially, of the expiratory murmur, or jerky movements; or there may be an occasional slight crepitation without any other sign. Our difficulty is increased when we remember that many of these signs occur in healthy individuals under certain conditions, more especially at the apex of the right lung. Another difficult group of cases is that of persons suffering from chronic emphysema, who develop suspicious signs at one or other apex. *Suspicious physical signs.*

In many instances we find, perhaps, general ill-health, a history of possible infection, and certain symptoms and physical signs which make us strongly suspicious of consumption; yet we cannot justly give the dogmatic opinion which may be needed to preserve the patient's health. The following three examples illustrate this difficulty :

1. A medical man two years before he consulted me *Cases.*

had suffered from pneumonia of the lower half of the right
lung, from which he made a good recovery.   There was
a history of tuberculosis in his family, and in consequence
there had been some exposure to infection.   A few months
before I saw him, he had experienced considerable loss of
weight, with slight harassing cough and scanty expectora-
tion.   The sputum on several occasions was found to be
free from tubercle bacilli.   On making a physical examina-
tion I detected at the right apex above the clavicle, and
especially in the right supraspinous fossa, a diminution of
the respiratory murmur, which persisted when he coughed,
but no further signs.

2. As an example of the class of suspicious cases in
which repeated attacks of fever occur without any definite
signs or symptoms, I would cite the following : A gentle-
man whom I saw with Mr. Mounsey at Camberley was
suddenly taken ill when working for an army examination.
Six months previously he had suffered from a febrile
attack without any other definite symptom.   When I saw
him he had been in bed for a week, with a continuous
temperature of 102·5° to 103·8° F., but had had no other
symptoms.   His blood had been examined, and Widal's
reaction had been obtained by a competent bacteriologist,
and consequently the question of typhoid fever was enter-
tained.   Neither Mr. Mounsey nor myself could find any
other evidence to warrant a diagnosis of typhoid fever—
in fact, the only abnormal physical signs we could detect
were slight loss of resonance on percussion, together with
a few scattered crepitations in the region of the left apex,
more especially on its anterior aspect.   Two days after I
saw him the fever rapidly subsided, and the only signs

of disease remaining were slight loss of resonance on percussion and diminished entry of air at the left apex.

3. A patient whom I saw with Dr. Rashleigh gave a history of pleurisy five years before, but of subsequent good health. He had recently become anæmic, and was troubled by a slight cough, with scanty expectoration, in the morning. There was a certain amount of wasting, and the digestion was impaired. Tuberculosis was strongly marked in the family. On examination I found in the right axilla a certain number of crepitations, which were probably due to the attack of pleurisy; at the right apex the respiratory murmur was deficient on ordinary respiration, and on deep respiration the expiratory murmur was prolonged. The sputum contained no tubercle bacilli, but *Diplococci pneumoniæ* were present in large numbers.

What are we to say in such cases as these, if, after *What course should be* repeated examination of the sputum, we are unable to *taken in cases of this kind?* demonstrate the presence of tubercle bacilli? If we say that there is no definite evidence of tuberculosis, our patients are apt to be careless and to forget that, even if they are not suffering from this disease, they are extremely likely to contract it. On the other hand, we are not, I think, acting rightly if we assert that tuberculosis is present, and order our patients' lives in accordance with this *Some get well on simple* opinion. In many suspicious cases the patients get quite *simple treatment.* well on simple treatment.

A lady whom Mr. Herbert Allingham, who had seen her *Case.* for some surgical trouble, advised to consult me three years ago, was anæmic, losing weight, and suffering from cough and slight expectoration, together with impairment of digestion. On examination I found that the cough might

be accounted for by the condition of the throat, but that there were distinct bronchophony and slightly impaired percussion note at the right apex, together with marked prolongation of the expiratory murmur. The patient was placed on a simple mixture of aloes and iron, and rapidly improved. At the present time there are no suspicious signs in the chest.

Others are really suffering from consumption.

The majority, however, of these cases do not improve in this way, and we should adopt other means of determining their true nature. Many patients suffering from tuberculosis, who present only suspicious symptoms and physical signs, will, it is true, improve very much, and, in fact, appear to have completely regained their health, if we treat them for a few weeks on the ordinary lines of rest and tonics, but the disease only becomes dormant, and is not arrested. In too many instances these patients, sooner or later, break down. When this occurs the disease is more extensive, and the chance of effecting a permanent arrest of the pathological processes is not nearly so great as if we had been able to give a positive diagnosis in the early stages, and so had been able to insist on a prolonged course of treatment. My experience is, as might be expected, that if a patient cannot get a definite opinion that he has tuberculosis, he will not take any great care of himself, but that if we are able to state positively that tuberculosis is definitely present, and that the chances of permanent arrest of the disease are extremely hopeful, then he will make very great sacrifices.

When we are in doubt as to the presence of tuberculosis, we must, as we have seen, carefully investigate the past

history of the patient. We must also make repeated and thorough physical examinations of the whole of the chest, being especially careful to examine the supraspinous fossæ and to make the patient thoroughly expand his chest.

In examining the chest, it is essential, as I have already pointed out, that we should ask the patient to cough during auscultation. Sometimes crepitations which appear persistent clear up during the act of coughing. Such crepitations are of no pathological importance. Sometimes the breath-sounds appear nearly normal, and no crepitations are heard until the patient coughs, or immediately afterwards. Such post-tussic crepitations are of great pathological importance, and their presence or absence should always be determined. In certain instances in which we are doubtful whether consolidation is present or not, we may obtain additional information from what is called auscultatory percussion— that is to say, from the simultaneous use of auscultation and percussion. In all cases of doubt the expectoration should be repeatedly examined for tubercle bacilli. If after repeated examinations for bacilli none can be discovered, some of the expectoration may be inoculated into a guinea-pig. Five weeks must elapse, however, before this method can give any definite result.

If we are still unable to give an opinion one way or the other, what are we to do ? Several special methods have been employed to facilitate the early diagnosis of consumption. For instance, the X rays may show some opacity, speckling or thickening at one or other apex ; or, as Walsham and Bonnet Léon have pointed out, it is sometimes possible to diagnose early pulmonary tuber-

Special methods for determining the diagnosis.

culosis by demonstrating a diminished or irregular action of the diaphragm on the affected side. Again, it has been claimed that we may obtain agglutination of tubercle bacilli by means of the patient's serum—a test which is similar to Widal's test for enteric fever, and this is certainly true of the later and well-marked stages of the disease. The recommendation that potassium iodide should be administered with the object of causing a reaction in the affected portion of the lung, and so bringing out crepitations, is not unattended with danger, and needs only to be mentioned to be condemned.

These and similar methods have been advocated from time to time, but none of them are reliable in the early and indefinite stages of the disease.

The opsonic index.   Recently what is known as the opsonic index, or estimation of the protective substances in the blood, has been introduced by Wright and Douglas as a method for making the diagnosis in a doubtful case of tuberculosis, and also of regulating the use of tuberculin in the treatment of this disease.

In the natural process of resisting disease due to microorganisms, the blood appears to play a major part. What this part exactly is cannot yet be stated. It is held by many authorities that the serum plays some—it may be the chief—part in our protective mechanism, and that among other things it acts on bacteria in such a way that it tends to make easier their destruction by the phagocytes. This power of rendering bacteria more 'digestible' is termed the opsonic power of the blood. According to Wright, it is not possible to isolate any bodies which are

the cause of this property, although it is convenient to use the term 'opsonins' for the hypothetical bodies. Each disease due to micro-organisms is said to have a different opsonin—in other words, opsonins are specific. It is not known how these various bodies are produced, whether they are the result of cell metabolism or not. Wright and Douglas have introduced an ingenious method of measuring the quantity of opsonins in the blood of any disease such as tuberculosis. This method is fully described in the Appendix (p. 242). Its object is to ascertain the power of a given serum to increase the ingestion of particular micro-organisms by normal phago-cytes. In the case of tuberculosis, a definite quantity (x) of tubercle bacilli is mixed with a definite quantity (y) of healthy serum and with a definite quantity of healthy leucocytes which have been washed free from all the contents of healthy serum. This mixture is incubated, and after a certain time films are made of its contents and stained. The number of bacilli in at least forty con-secutive polymorphonuclear cells is then counted. This number is regarded as being the normal—*e.g.*, 112, or an average of 2·8 per cell.

Method of determining the opsonic index.

Simultaneously with the above, the same quantity (x) of tubercle bacilli is mixed with the same quantity (y) of serum from the patient suspected of suffering from tuber-culosis, and with the same quantity (z) of healthy washed leucocytes. This mixture is treated in the same way as the mixture of healthy serum, and the number of bacilli in at least forty consecutive polymorphonuclear cells is counted—*e.g.*, 56, or an average of 1·4 per cell. The number of these bacilli divided by the number of bacilli

counted in the phagocytes of the healthy serum gives the opsonic index—*e.g.*, $\frac{5 \cdot 6}{11 \cdot 2} = 0 \cdot 5$.

The amount of opsonins against tuberculosis in the blood (what is termed the opsonic content of the blood) undergoes variations in the consumptive, and, we are told, also in the apparently healthy individual. When the quantity of opsonins is increased, we speak of a positive phase, and when the quantity is decreased, of a negative phase. For example, if a consumptive gave an index of $0 \cdot 5$ and then of $1 \cdot 3$, we would say that the first represented a negative phase and the second a positive phase; whilst if a consumptive gave an index of $0 \cdot 7$ and then of $0 \cdot 4$, we would say that the first represented a positive phase and the second a negative phase.

When tuberculin is injected—and presumably when the tuberculous toxin is secreted within the body—the train of events is said to be as follows:

1. A period of intoxication, which is characterized by a decline in the antibacterial power of the blood.* This decline or 'negative phase' is more or less prolonged, according as a larger or smaller amount of tuberculin is given, and presumably when a larger or smaller amount of toxin is present. If the negative phase is prolonged it may be accompanied by fever and constitutional disturbance.

2. The negative phase is followed by a 'positive phase.' This phase, the characteristic feature of which is an increase in the antibacterial power of the blood, corresponds to a period of increased resistance.

* The opsonic power of the blood is included in the general term 'antibacterial power,' but would not appear to be the only factor.

3. The antibacterial power of the blood may remain at a somewhat higher level than before the primary negative phase for perhaps a month or more, but usually sinks back in about ten days to its previous level.

We are now in a position to consider the deductions which Wright and others hold may be drawn from the opsonic index of a given patient suspected of having consumption. It is held that, in view of the unreliability of the technique and the fact that the opsonic index fluctuates, at least four or five consecutive observations should be made before any definite conclusion is formed. With this reservation, it may be said at once that these observers hold that if the opsonic index is above or below what are held to be the normal limits of 0·8 to 1·2, the patient either is suffering from tuberculosis or is predisposed to it. If the index is persistently 1·5, 1·7, or higher, we are asked to regard this as conclusive evidence of tuberculosis. A high index, such as 1·5, is said to indicate either a high resisting power or systemic infection. If the index varies, and is 0·5, then 1·4, then 0·7, and then 1·5, it is said to be evidence of low negative phases and high positive phases, and to be the result of systemic infection by tuberculosis. If the index is persistently low—0·6 or 0·5—it is said to mean that the patient either has localized or 'closed' tuberculosis, or is predisposed to it. If a bacteriologist obtains the last result, he will usually ask the clinician whether there are any symptoms of tuberculosis present before he gives an opinion. In the case of localized tuberculosis the index is seldom above 0·6.

Great hopes of the value of the opsonic index, both for the purpose of the diagnosis and of regulating the treat-

Meaning attached by Wright to the opsonic index.

ment of tuberculosis, were raised after Wright's work was published. More recently there has been some scepticism as to its value. The work is intensely interesting, but further experiments, more especially those by Dean, tend to show that our knowledge of the subject is far from being comprehensive, and that it is unwise to make clinical deductions, in the diagnosis or treatment of pulmonary tuberculosis, from this method at present.

Value of the opsonic index in diagnosis.

As far as my own experience goes, I have not obtained any information of value by the use of the opsonic index in cases of suspected early consumption. Apart from that, however, it may be pointed out that the technique of the method is open to many errors, that it requires a skilled bacteriologist and considerable expenditure of time, and that even then it is probable that the personal error in a given observation may amount to 25 per cent. Again, a man who suffers from active consumption, and whose opsonic index before treatment is low, often does not show any increase in his opsonic index under sanatorium treatment. He may have lost all physical signs of active disease, have put on weight, regained his activity, lost all fever, and all bacilli may have disappeared from his sputum, and yet his opsonic index is not increased. In other words, a case which the clinician regards as arrested has an opsonic index of no higher value than a case in the early stages of untreated tuberculosis. Sanatorium treatment alone, therefore, in many cases does not do anything to increase the protective substances of the blood, if it be true that the opsonic index is an index of these protective substances. Such a result is necessarily hostile to clinical experience, and should make us pause before accepting the statements concerning opsonic indices at their face value.

The question of the value of the opsonic index in connection with the treatment of tuberculosis is considered on p. 177.

We can arrive at a correct diagnosis in cases in which consumption is suspected by employing Koch's *old* tuberculin, provided that it is used under certain definite conditions.

Tuberculin was the name applied by Koch in 1890 to a clear, thick, amber-coloured, aromatic-smelling fluid which represents a glycerine extract of the cellular metabolic products of the tubercle bacilli, and contains one or more toxic bodies which may be either of the nature of a ferment, albumin or alkaloid. It is prepared by growing tubercle bacilli (not necessarily human or virulent) for six to twelve weeks at the body heat in large flasks, containing glycerine and veal broth, in the presence of a sufficiency of oxygen. The growth is then evaporated to a tenth of its volume over a sand-bath, and finally filtered twice through a porcelain filter. In this manner all the micro-organisms are removed and a concentrated solution obtained, which keeps indefinitely in its undiluted state owing to the high proportion of glycerine it contains. The use of tuberculin fell into disrepute very soon after Koch's somewhat premature disclosure, chiefly owing to the fact that Virchow asserted that tuberculin injections, in some cases, tended to generalize the disease. Virchow's statement was upheld by a report of eight physicians of the Brompton Hospital, which was signed by Dr. C. Theodore Williams and Dr. John Tatham, and there can be no doubt that, when given in the doses and in the class of case in which it was given in the early days, tuberculin is a dangerous weapon. I would point out, however, that the larger number of

Objections to tuberculin.

cases treated, when the discovery was first made, were examples of advanced disease with secondary infection, in which febrile symptoms were present, and that tuberculin was given in frequently repeated and often large doses.

We have learnt that this remedy should not be used if there is fever, advanced disease, or secondary infection. The amount injected must be small, and the injections should not exceed three, or at most four, in number. Tuberculin should never be employed where there is evidence of extensive disease. For instance, it should not be employed to find out whether an attack of general bronchitis is tuberculous or not, or to make a diagnosis between bronchiectasis and tuberculosis. If the physical signs point to extensive mischief, and we are in doubt whether the disease is tuberculous, we should not use tuberculin, because of the experience of Virchow and others. Nor should we use it when we are certain of our

diagnosis by other means. For example, a man was admitted some time ago into St. George's Hospital for the purpose of clearing up the diagnosis by means of this agent. I had seen him on several occasions, and was suspicious of tuberculosis, as he was anæmic and constantly 'catching cold.' The only physical signs present, when I first examined him, were diminished resonance, slight wasting, and deficient entry of air at the left apex. Before using the tuberculin I again examined his chest—he had not been to the hospital for a couple of months—and found that in addition to the above signs and symptoms, there were a few crepitations at the end of inspiration over the left clavicle. These persisted, and a definite diagnosis was made without the aid of tuberculin.

When the disease is so slight that a diagnosis cannot be made by means of the physical signs, and no tubercle bacilli can be detected in the sputum, then I believe that one, two, or three small injections of Koch's old tuberculin may be employed without the slightest risk. There is no recorded instance in which any bad results whatever have followed the injection of this substance when made with proper precautions and under suitable conditions. Professor Osler, taking part in a discussion raised by Heron at the last British Congress on Tuberculosis, said that he regarded the old form of tuberculin as a safe and efficient diagnostic agent, and that he used it as a routine practice in the wards at the Johns Hopkins Hospital. We may rest assured then that, under proper conditions —that is, the absence of definite signs of extensive disease, the absence of fever, and the employment of small doses—there is no danger whatever in the use of tuberculin as a diagnostic agent in the early stages of consumption.

No risk if tuberculin properly used.

We must now consider the effects, and their significance, of the use of tuberculin. If we obtain a reaction—that is, if the injection is followed by an appreciable rise in the patient's temperature—can we assert that the case is one of tuberculosis? And, again, if we fail to obtain a reaction after three, or possibly four, injections, can we positively exclude tuberculous disease?

Value of a tuberculin reaction.

If we obtain a reaction, can we assert that the case is one of tuberculosis? With regard to this question, Goldschmidt, Babes, and Kalendro have obtained a reaction in cases of leprosy. Netter stated that he obtained the reaction in 27 out of 100 cases where the

Positive value.

patients were afflicted with other diseases than tuberculous disease of the lungs. Strauss and Teissier have observed a reaction in syphilitic subjects. With regard to leprosy · we might perhaps expect a reaction, but this disease need not be considered in connection with the diagnosis of tuberculosis in this country. In the case of the other diseases in which tuberculin is stated to have given a reaction, there is not sufficient proof, in the shape of post-mortem examinations or other evidence, to show that the patients did not also suffer from tuberculosis. Klebs, jun., states that he obtained a reaction in every case of chlorosis; but this is the experience of no other observer, and requires confirmation. Against these statements we have Koch's assurance that, after an experience of some 3,000 cases, he considers the tuberculin test to be almost absolute, and we have in addition the evidence gained from the examinations of cattle slaughtered after a tuberculin reaction has been obtained. Dr. France's observations in this connection are of great interest. This observer, in an investigation of the frequency of tuberculosis in association with insanity, injected fifty-five patients at the Claybury Asylum with tuberculin. In forty-five cases a characteristic reaction was obtained. Thirty-four of the patients who gave a reaction have since died; a post-mortem examination was made in twenty-nine instances, and in every case active tuberculosis was found. Five of those patients who did not give a reaction died subsequently, but in none of them was any trace of tuberculosis detected.

Negative value.

Do we ever fail to obtain the reaction when tuberculosis is present? Cornet refers to a few cases in which tubercu-

losis was certainly present, but in which no reaction was obtained when tuberculin was injected; J. M. Anders of . Philadelphia, who is a firm believer in the diagnostic value of tuberculin, has seen cases in which there was no reaction, although a post-mortem examination showed the presence of tuberculous lesions. Knopf also considers that tuberculin may fail to show the presence of disease in some instances. It is certainly true that no reaction may follow if tuberculin is injected into cattle suffering from advanced tuberculosis and high fever. This would appear to be due to the fact that so much poison is already being secreted within the body that a small dose of tuberculin has no appreciable effect. There is no proof as yet that tuberculin ever fails to give a reaction when the extent of the tuberculous lesion is limited. The negative value of no reaction, however, is not as great as the positive value of a definite reaction. We have no absolute certainty in medicine, and must always remain satisfied when an overwhelming majority of cases give a particular sign or symptom, and in this respect we may compare the tuberculin reaction very favourably with what is known as Widal's reaction.

The following is the method which I employ in utilizing the tuberculin test. It is important to remember that the diagnostic form of tuberculin is the old tuberculin, and not one of the various other forms referred to on p. 171. The old tuberculin of Koch—which is free from tubercle bacilli—is diluted with a 0·5 per cent. carbolic acid solution, until a 1 per cent. solution of tuberculin is obtained. This solution does not keep. No more of the dilution should be prepared than is likely to be suffi-

Details of injection.

cient for the requirements of a few days, and as soon as the solution becomes at all turbid it should be thrown away. *The requisite dose is measured by volume, and expressed in terms of the cubic centimetre.* The patient's temperature — preferably of the rectum — is taken every four hours for three days before the injection is made. If there is any appreciable fever the injection must be put off for a time. The injection gives rise to least inconvenience when it is given beneath the skin of the back, between the scapulæ, the surface being sterilized with alcohol. After injection in a tuberculous patient there is a rise of 1° to 3° F., which is accompanied by a feeling of nausea and occasionally vomiting. At the seat of the tuberculous lesion there is always hyperæmia after the injection, which is known as the local reaction. The temperature must also be taken every four hours for forty-eight hours after the injection is made.

Amount to be injected.

With regard to the amount of tuberculin used, our object should be to inject just sufficent to cause a rise of temperature—that is, we must endeavour to avoid causing a greater rise than is absolutely necessary. I commence with 0·001 c.c. of tuberculin in the case of adults (0·0005 c.c. for children). This is most safely accomplished by using a syringe of 1 c.c. capacity, containing a 1 per cent. solution of tuberculin, and injecting a tenth part of its contents. A rise of temperature of 1°-2° F. may be considered to be a positive reaction. It is important to remember that under exceptional circumstances the rise of temperature may be delayed for thirty-six hours. If no reaction follows I wait three days, and then inject 0·002 c.c. (for adults). If there has been some

Meaning of reaction.

If no reaction, further injections must be employed.

oscillation of temperature, but no definite reaction, after the first injection, 1 cubic millimetre may be sufficient for the second dose. If there is still no reaction, I again wait three days and then inject 0·005 c.c. (for adults). If there is no reaction now, tuberculosis can be excluded. When dealing with a patient who is less robust, or in whom the symptoms and signs are more suspicious, I use smaller initial injections. The patient must be kept in bed after the injection until the reaction has passed off—that is to say, for about twenty-four to forty-eight hours.

The following three cases, which I demonstrated at the Brompton Hospital in connection with a lecture on this subject, serve as examples of the utility of tuberculin in suspicious cases.

It will be noticed that in each of these examples (1901) I used larger initial doses, and that in one case of non-tuberculous disease as much as 0·01 c.c. was given. Later knowledge tends to show that these doses are too large, and that the doses recommended above should be used.

1. The patient was a man, aged twenty-six years. He Cases. complained of cough with wasting and weakness during the previous year. He had an attack of pleurisy three months before admission. The physical signs were as follows : On the right side the expiratory murmur was a little prolonged and high-pitched in front ; at the apex and in the supraclavicular fossa an occasional click was heard, which disappeared after coughing. On the left side there was diminished resonance in front, and the breath-sounds, more especially behind, were prolonged and high-pitched. There were no tubercle bacilli in the

sputum.   On August 23, 0·005 c.c. of tuberculin was
injected at noon.   At eight o'clock next morning the
temperature rose to 102° F., but it gradually fell and
reached the normal on the 26th.   A positive diagnosis of
tuberculosis was then made (see Fig. 1).

2. The patient was a man, aged forty-five years.   His
health had been indifferent.   He had had an attack of
pleurisy in 1893.   The physical signs were as follows:
The resonance to percussion was slightly impaired in the
left infraclavicular fossa, first and second spaces.   The
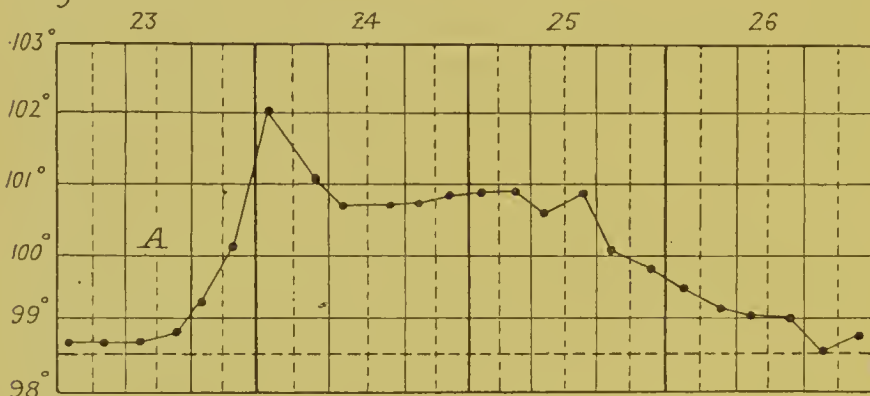
FIG. 1.

August 23.   Injection of 0·005 c.c. of tuberculin.

spine of the left scapula was less resonant to direct per-
cussion than was that of the opposite side.   Expiration
was a little harsh and prolonged in the supraspinous fossa.
Nothing else abnormal was found in the lungs.   No
tubercle bacilli were found in the sputum.   An injection
of 0·005 c.c. of tuberculin was given on the evening of
August 24, and in less than twenty-four hours the tem-
perature had reached 100·4° F.   A positive diagnosis of
tuberculosis was therefore made (see Fig. 2).

3. This case is of interest, as it shows the value of

tuberculin in excluding tuberculosis. The patient was
a man, aged fifty-seven years. He had had pleurisy
eighteen years ago, otherwise he was well till 1898; since
then he had suffered from a cough, shortness of breath,
and dyspepsia. The physical signs were those of general
emphysema. In addition, the apices of the lungs were
not free from suspicion. The percussion note was im-
paired at the left apex, and the inspiratory murmur was
high-pitched. The vocal resonance was somewhat in-
creased in both infraclavicular fossæ, and there were fine
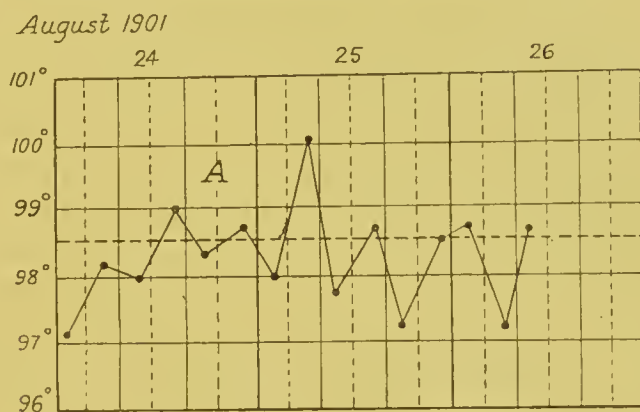
FIG. 2.

August 24.   Injection of 0·005 c.c. of tuberculin.

rales, especially at the left apex. No tubercle bacilli were
found in the sputum. On September 1, 0·005 c.c. of
tuberculin was injected, but there was no reaction at all.
On October 14, as the man's condition was somewhat
worse and the cough was more frequent, a further
examination of the sputum was made, and a report was
returned that a number of tubercle bacilli were present.
The report was viewed with suspicion, and on the 23rd
0·005 c.c. of tuberculin was again injected, and again
there was no reaction. The sputum was repeatedly

examined after October 14, but no tubercle bacilli were found, and there seemed to be no doubt that, owing to some mistake on the part of a hospital porter, the report of October 14 was not based on the sputum of this patient. A further injection of 0·01 c.c. of tuberculin was given on the 30th, but no reaction followed. Tuberculosis was therefore excluded in this case (see Fig. 3).
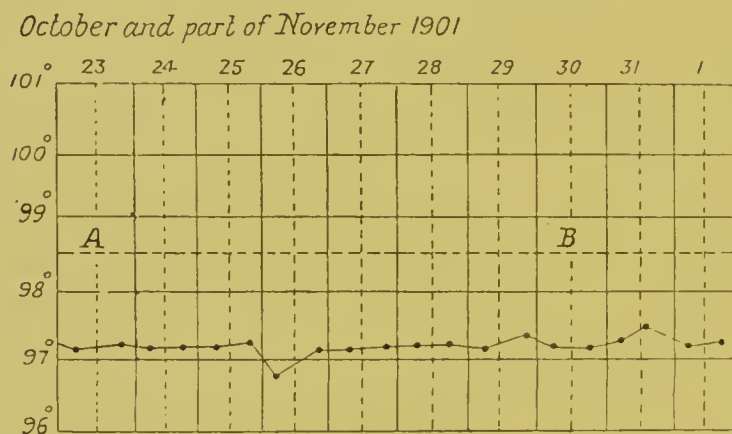
FIG. 3.

A (October 23), Injection of 0·005 c.c. of tuberculin ; B (October 30), injection of 0·01 c.c. of tuberculin.

(b) *The Later Stages of the Fibro-Caseous Form.*

The diagnosis in these cases is usually unattended with difficulty. If there are signs of persistent catarrh, consolidation, or excavation in the region of the apices of the lungs, we may conclude in the great majority of cases that we are dealing with tuberculosis. *In those cases of chronic pulmonary disease, in which for various reasons it may be difficult to exclude tuberculosis, there is only one way of arriving at a positive conclusion, and that is by the demonstration of the presence of tubercle bacilli.* We may frequently demonstrate the presence of these micro-organisms

by the ordinary staining methods (see Appendix, p. 239), Importance of demonstrating the presence of tubercle bacilli. but if repeated examinations fail to show bacilli by these means, we must have recourse to inoculation experiments. If both ordinary staining methods and inoculation experiments fail to show the presence of tubercle bacilli, we may safely exclude tuberculosis. The use of tuberculin is not justifiable, as the disease is too extensive, but the X rays not infrequently enable us to give a diagnosis in doubtful cases of the disease in its later stages.

II. Chronic Fibroid Tuberculosis.

The question whether any given case of consumption runs a chronic course or not depends largely on the development or non-development of fibrous tissue. If we use the term in its pathological sense, then all cases of healed or healing tuberculosis are examples of fibroid tuberculosis; but, unfortunately, the term has of late years been restricted to what is called fibroid phthisis. The lesions in this form Meaning of fibroid phthisis. of the disease are usually extensive, and involve considerable alterations in the appearance of the chest and in the position of internal organs, more especially of the heart. Such cases are either due to tuberculous conditions which have run a fibroid course, or to fibroid conditions— following on pneumonia, pleurisy, anthracosis, and the like—which have become tuberculous. In some instances no positive diagnosis can be made from the physical signs, largely because extensive fibroid disease is frequently masked by a compensating emphysema. In others we Must demonstrate presence of bacilli. may be able to come to a definite conclusion from the history of the disease, the character of the temperature, and the general symptoms, but we cannot be certain of

our ground unless we are able, as in the last group, to demonstrate the presence of tubercle bacilli.

III. IRREGULAR FORMS.

Tuberculosis is not infrequently grafted on to other forms of pulmonary disease, or the presence of pulmonary tuberculosis may be masked by some prominent symptom. In this manner we may have tuberculosis supervening on a long-standing case of bronchitis or of emphysema, or we may meet with examples of tuberculosis in which the main feature is pleurisy with or without effusion, bronchitis, or laryngeal obstruction. In all such cases it is easy to overlook the presence of tuberculosis, and the only means we have at command for making a positive diagnosis of tuberculosis is by determining the presence of Emphysema. tubercle bacilli. In emphysema there may be some flattening or dulness at one or other apex, or the physical signs may be entirely masked by the emphysematous condition of the lungs, and our suspicions may be only aroused by the character of the temperature, or by marked Pleurisy. wasting. It is well to view all cases of pleurisy with suspicion, especially in childhood and early adult life, for there is evidence to show that the greater number are primarily tuberculous, and that a large proportion of the remainder subsequently suffer from consumption. In fact, if it is not clear that an attack of pleurisy in a young adult may be attributed definitely to a pneumococcic, septic, rheumatic, or other non-tuberculous origin, we should always regard the case as one of tuberculous disease. The prognosis in such cases is much better than many authors would lead us to believe; but this good

prognosis depends upon the prompt and efficient treatment of each case on lines identical with those of pulmonary tuberculosis. Many cases of generalized bronchitis are in Bronchitis. reality tuberculous. This is especially true in the terminal stages of such diseases as chronic nephritis and cirrhosis of the liver. If we find that this disease is associated with irregular fever and wasting, and does not respond to treatment, we should examine the sputum. This class of case has not received the attention which is its due. I frequently see patients who, after suffering for years from bronchitis, gradually begin to waste, and who have an irregular temperature. In such instances it may be quite impossible to detect any physical signs of tuberculosis, and the key to the diagnosis lies in the presence or absence of bacilli.

A commercial traveller, aged sixty-three, who for ten or Case. more years had suffered from bronchitis, consulted me chiefly because he could obtain no relief from a distressing cough. Ordinary remedies had no effect, and as he was rapidly losing flesh, and as his temperature was irregular, the sputum was examined. Tubercle bacilli were found. The man gradually lost ground, and six months later died from an attack of hæmoptysis, which occurred during his sleep. At no time could I find any evidence by physical examination of the presence of tuberculosis.

Primary tuberculosis of the larynx is excessively rare, Laryngitis. but it is not uncommon to find secondary tuberculosis of the larynx entirely masking all signs of the primary lesions in the lungs.

CHAPTER III

THE DIAGNOSIS OF THE ACUTE FORMS OF PULMONARY CONSUMPTION.

I. THE ACUTE BRONCHO-PNEUMONIC FORM.

THIS is the commonest of the acute forms, and occurs more frequently in childhood than in adult life.

In adults. In adults this form of the disease is uncommon. It is almost impossible to distinguish between a simple and a tuberculous broncho-pneumonia by the physical signs and general symptoms, unless there is definite evidence of excavation in the lungs. Associated pleurisy is more common in the tuberculous than in the simple variety. Marked wasting and loss of strength, excessive night sweats, wide variations of temperature, an attack of hæmoptysis, or the slow resolution of the disease, may excite our suspicions, but many a case of simple broncho-pneumonia presents all these symptoms and recovers completely. We must carefully examine the sputum, and wait until we can demonstrate the presence of tubercle bacilli or of elastic tissue, before we give a positive diagnosis of tuberculosis.

In children. In children the diagnosis of tuberculous from simple broncho-pneumonia is still more difficult. Simple broncho-pneumonia may follow measles or whooping-cough

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and persist for some months, and we may be tempted to make a diagnosis of tuberculosis, only to find that all the signs and symptoms disappear. No disease teaches us so emphatically the necessity for the careful investigation of every detail connected with the case, and the danger of making a diagnosis except after repeated examinations. As a general rule, tuberculous broncho-pneumonia has an insidious onset; in fact, if an attack begins with acute symptoms in a child who has had previous good health, and has had the benefit of good surroundings, the broncho-pneumonia is, nine times out of ten, of a simple form, no matter, as Holt in his excellent account of this disease insists, what the physical signs are, no matter how prolonged or irregular a course the disease may run. If the fever becomes less and the condition of the child improves, we must not come immediately to the conclusion that we are dealing with a case of simple broncho-pneumonia. In tuberculous broncho-pneumonia we not infrequently have intervals of what appears to be comparatively good health, and we find that the symptoms may abate for a time, only, however, to reappear in an aggravated form. The diagnosis here, as elsewhere, must rest largely on the associated conditions. The appearance of the child may help us, but it is seldom wise to place much reliance upon this. Consumption is strongly suggested if there is marked evidence of the possibility of infection, such as the presence of a tuberculous individual in the house; or, again, if we find that the child has some other tuberculous lesion, such as testicular, spinal, or hip disease. Associated enlargement of the bronchial glands is conclusive, as, of course, is any

Diagnosis rests largely on associated conditions.

evidence of softening in the lungs. Occasionally a pleuritic rub may help us. Little stress can be laid upon the variations of temperature; still, if this is taken at frequent intervals, we may find comparatively large excursions which are more suggestive of a tuberculous than of a simple form of the disease. Our difficulties may be solved if we can obtain the sputum. Young children, however, mostly swallow this. On the other hand, when a child under six years of age expectorates profusely, this fact alone is sufficient to suggest a diagnosis of pulmonary tuberculosis. It is worth while to mention that the sputum may sometimes be obtained by giving the child a gentle emetic; failing this, it will sometimes be found possible to pick out little masses of purulent material from the fæces; these represent the swallowed sputum, and on examination may yield definite evidence of tuberculosis.

Case.
The following case exemplifies the difficulties that may be met in such instances. A few years ago I saw, with Dr. Rowe, a young boy who was laid up at school at Margate. His illness commenced in February with the symptoms of an ordinary cold, which developed into broncho-pneumonia of the upper part of the left lung. When I saw him, six weeks after the initial symptoms, the temperature, which had been irregular but had never reached the normal, was gradually declining. The boy did not appear to be very ill, and had not wasted to any marked degree. There was considerable flattening with loss of movement on the left side of the chest, but the heart's apex was not appreciably displaced. Over the apex of the left lung, more especially in front, there was

dulness, together with tubular breathing and broncho-phony; towards the axilla and in the region of the nipple there were dulness, loss of voice sounds, and diminished breath sounds. There was no increase of the cardiac dulness to the right, and no evidence of pericardial effusion. The diagnosis lay between tuberculosis, a slowly revolving pneumonia, and a localized collection of fluid or pus. No sputum was expectorated, consequently no examination for bacilli could be made. Several explorations were made in different positions of the chest with a large-sized exploring needle, but no pus was withdrawn, and the diagnosis of empyema was negatived. On one occasion a few drops of frothy fluid were obtained, but this was found to contain no tubercle bacilli. The physical signs were too extensive to permit the use of tuberculin, consequently we were unable to give a definite opinion as to whether the case was one of tuberculosis or of slowly resolving broncho-pneumonia.

Some weeks later I saw the boy in London with Dr. King, of Watford, when I found the physical signs so much diminished, and the extent of the lesion so much less marked, that we came to the conclusion that the case was probably one of slowly resolving broncho-pneumonia, although we told the boy's father that in such cases tuberculosis might readily supervene, and that his son should be treated, at any rate for a time, exactly as if we had given a diagnosis of tuberculosis.

II. The Lobar-Pneumonic Form.

We have learnt of late years that several varieties of micro-organisms, including the tubercle bacillus, are able ·

to cause lobar pneumonia, although the pneumococcus of Fraenkel is the one most commonly found. It is probable that the majority of cases of tuberculosis which come under this heading are really examples of confluent broncho- or lobular pneumonia, but many are primarily of the lobar variety. The distinction is, moreover, useful from a clinical standpoint.

In the majority of instances the onset is sudden, and both the general symptoms and the physical signs point to an ordinary attack of pneumonia, save that, in my experience, in tuberculosis of this type the patients are more anæmic and the respirations less frequent than in simple pneumonia. The upper lobes are more frequently affected, perhaps, than the lower. The temperature in this form of tuberculosis shows somewhat wider excursions than in pneumonia, but it is of the continuous type. Frequently the first thing which suggests that we are not dealing with an ordinary attack of pneumonia is the fact that there is no crisis, the fever persisting, perhaps, for weeks.

Diagnosis from pneumonia.

We can only differentiate the case as one of tuberculosis rather than pneumonia in the early stages of the disease by detecting tubercle bacilli in the sputum, which, however, is not infrequently absent during the first week or two, or in some instances by the fact that rapid excavation takes place in the lungs. In the later stages of the disease the marked wasting, the continuance of the high temperature, and the gradual progress rather than resolution of the disease, as shown by the physical signs, all militate against the diagnosis of pneumonia. In the majority of such cases, and especially in children, rapid

softening occurs in the affected part of the lung. This condition is soon followed by the formation of a cavity. In many cases the disease then becomes quiescent, and does not spread to the neighbouring portions of the lung. In some cases complete arrest follows.

In other cases both the temperature and the aspect of the patient suggest enteric fever complicated by pneu- Diagnosis monia rather than tuberculosis. This suggestion is from typhoid fever. frequently supported by the presence of diarrhœa.

Enteric fever may be excluded by the absence of the characteristic eruption or of enlargement of the spleen, and by the failure to obtain Widal's reaction, or to demonstrate the presence of typhoid bacilli in the urine.

In 1901 I saw, with Mr. Higgins at Cambridge, an under- Case. graduate of Trinity College, who afforded a good example of the difficulties of diagnosis in the lobar-pneumonic form of the disease. The patient had been suddenly seized with high fever, a general feeling of weakness, and diarrhœa. On examining him we found well-marked consolidation of the upper portion of the right lung. At the same time there was some distension of the abdomen, together with diarrhœa, which was suggestive of enteric fever. The temperature was of the continuous type, varying between 102° and 103·5° F. The general symptoms pointed at the onset to typhoid fever, complicated with pneumonia; but the absence of rose spots, the absence of enlargement of the spleen, and the failure to obtain Widal's reaction, although this test was made on two occasions, negatived this idea. The wasting and the marked anæmia, and the absence of any crisis, suggested that the physical signs were due to tuberculosis, and not to pneumonia,

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but as there was no expectoration this suspicion could not be verified. The continuance of high fever, together with marked anæmia, suggested the possibility of malignant endocarditis, but no confirmatory evidence was obtained; there was no murmur and no infarction. By the process of exclusion we formed the opinion that we were dealing with a case of acute lobar-pneumonic tuberculosis. Signs of lung destruction developed in the course of the next few weeks, and our diagnosis was confirmed. The patient's general condition gradually improved, but when I saw him two months later in London he had the physical signs of a cavity at the right apex. He went to a sanatorium; the disease was arrested. He has remained well, and is now engaged in rather laborious work.

Lobar pneumonia with empyema.

There is another group of cases which at first appear to be examples of simple basal lobar pneumonia. The disease runs a normal course, and is followed by a crisis. The lungs then fail to make much, if any, progress towards resolution, and, finally, an accumulation of pus collects. What appear to be ordinary cases of pneumonia are not so very infrequently followed by an empyema, but many of these in reality are tuberculous from the commencement. It is a good plan whenever there is any doubt, to have both the sputum and the fluid, removed from the chest, examined for tubercle bacilli.

III. ACUTE MILIARY TUBERCULOSIS OF THE LUNGS.

In many cases of acute miliary tuberculosis there are no special pulmonary symptoms, but there is a distinct group in which such symptoms are well marked. Acute miliary

tuberculosis often occurs in the final stage of pulmonary ^{Cause.} consumption, but it is rather with those cases which are not engrafted on previous extensive disease, but which follow on some circumscribed old lesion, that I wish to deal. We have to diagnose this form of the disease more especially from enteric fever with bronchitis and from acute bronchitis. In the first place, it is rare in a case of this kind to discover tubercle bacilli in the sputum, as there is seldom any destruction of lung tissue ; nevertheless, repeated examinations should be made for these micro-organisms. We must also search for evidence of the presence of tuberculous disease in other portions of the body, such as the epididymis and hip-joint, as our suspicions may often be confirmed in this way. There is usually much more marked prostration and wasting than is found in the early stages of enteric fever. In acute tuberculosis there are not infrequently marked differences Diagnosis in the respiratory murmur in different parts of the lungs from typhoid fever. —harsh and prolonged in some situations, feeble and indistinct in others. Again, very marked dyspnœa, 40 to 50 or more respirations a minute, and definite cyanosis, are characteristic of this disease, and seldom occur in the early stages of enteric fever. The temperature may not be raised at all in cases of miliary tuberculosis with marked debility; it is usually less continuous and lower (being seldom much above 102° F.) than in enteric fever, and is sometimes of the inverse type. An enlargement of the spleen occurs in both diseases, but is more marked in enteric fever. An Ehrlich reaction is found in both conditions. The presence of the characteristic rash, or the demonstration of Widal's reaction, afford definite evidence

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of enteric fever. After the first week the symptoms of enteric fever are, as a rule, sufficiently pronounced for us to make our diagnosis.

The clinical picture of miliary tuberculosis may be still more closely simulated by acute bronchitis of the smaller tubes. Our suspicions are usually aroused by the marked wasting, feeble reaction to the disease, and especially by the great cyanosis and excessive rate of the respirations. The diagnosis is certain if we can demonstrate the presence of tubercles in the choroid, or of tubercle bacilli in the blood, but these forms of evidence are seldom obtained. The first piece of definite evidence in favour of miliary tuberculosis not infrequently is the fact that the patient shows slight intolerance of light and retraction of the head, or develops other characteristic symptoms of meningitis.

A seaman admitted under my care when in charge of the wards of the Seamen's Hospital, Greenwich, was suffering from great prostration and marked wasting. He said his illness had extended over three or more weeks. He was cyanosed; his respirations were nearly 50; his pulse feeble; his temperature 101·5° F. The only physical signs I could detect of any disease were those of a generalized bronchitis. In view of the great weakness, the cyanosis, and the rapidity of the respirations, combined with the signs of a general bronchitis, a provisional diagnosis of acute miliary tuberculosis was made, and this was confirmed by an examination of the lungs after death.

A gentleman whom I saw with Dr. Fleck, at High Wycombe, began to feel disinclined for work. Then he developed definite signs of bronchitis. The absence of

relief with ordinary remedies, and the facts that the temperature was persistently high, that cyanosis was unduly marked, and that wasting was persistent, led to a diagnosis of acute tuberculosis being hazarded. A few days afterwards this patient developed signs of meningitis, passed into a state of coma, and died.

CHAPTER IV

THE AVOIDANCE OF REINFECTION

THERE is no doubt that every person afflicted with pulmonary consumption may be a source of danger to other people. Although absolute proof is difficult, there is but little doubt also that, even if he has already contracted consumption, a man is liable to be further infected, or, in other words, to be reinfected, either from himself or from other people suffering from the disease. Tubercle bacilli undoubtedly differ in virulence; thus, those found in scrofulous glands are less virulent, as a rule, than those obtained from the sputum of a consumptive patient. Again, the bacilli expectorated by different persons also vary considerably in the rapidity with which they infect animals. A tuberculous individual may accordingly be reinfected with Koch's bacilli of a greater virulence than those which have already established a hold upon him. In the treatment of tuberculosis, therefore, the avoidance of further infection is of the first importance. The true significance of the methods adopted for this purpose will be more thoroughly grasped if the conditions under which infection may be carried are first of all considered.

It is generally conceded that no one can be infected with tuberculosis save through tubercle bacilli derived

Question of the virulence of the bacilli.

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from pre-existing disease, either in man or domesticated animals, such as cattle. It is also generally allowed that Conditions for infection. the question of infection involves not only the presence of tubercle bacilli of a sufficient virulence, but also a certain condition of health—in other words, a certain condition of the 'soil' or tissues which allows the bacilli to induce the changes constituting tuberculosis.

The direct transmission of tuberculosis from parent to Sources of infection. offspring before birth is so rare that we may, for our present purposes, neglect it. The bacilli may enter the body by means of inoculation—that is, through the skin, and, causing disease at the point of entrance or in neighbouring tissues, may subsequently attack the lungs—but infection by this channel is comparatively uncommon, and in any case the infective material is derived from the same sources as in primary pulmonary infection. The sources of infection may, therefore, be discussed under two headings — namely, infection from human beings suffering from various forms of tuberculosis, and infection from animal sources, more especially from cow's milk.

Infection from Human Sources.

The one subject upon which there was complete unanimity at the last Congress on Tuberculosis was that the most potent factor in the spread of infection is the expectoration of tuberculous individuals. It is true Importance of sputum. that infection may arise from tuberculous disease of other organs or parts of the body than the lungs—for example, by means of a discharge from a tuberculous bone—but the spread of infection from these sources is not so great as

in the case of pulmonary consumption, although it follows the same lines, and, as we shall see, necessitates very similar precautions—namely, the efficient destruction of any contaminating discharge. It has been shown that enormous quantities of bacilli may be expectorated by a consumptive patient. Nuttall has calculated that a single individual may expectorate as many as 4,000,000,000 in twenty-four hours, while Bollinger and others assert that one cubic centimetre of sputum may contain a million. Kitasato has shown that a large proportion of the expectorated micro-organisms are dead or non-virulent, yet there is no doubt that a large number of virulent bacilli may be thrown into the air by a consumptive person.

The bacilli which owe their origin to the expectoration of a consumptive individual may be distributed in a few cases by direct contact. For example, infection may be conveyed by the act of kissing, or by means of an infected glass, spoon, or other article. Again, infection may be conveyed by means of the hands. Certain observers, such as Baldwin and Bryce, have shown that, whilst no tubercle bacilli could be found on the hands of sanatorium patients who used pocket-flasks but no handkerchiefs, the hands of ordinary consumptive patients who used handkerchiefs were infected in no less than 80 per cent. of the cases examined. The chief ways in which infection is conveyed by the expectoration are: (1) By the sputum being mixed with, or itself converted into, dust, and so distributed by any movement of the air. Infection may also occur by the dust being directly conveyed to the mouth ; for example, young children may play about the floor and then suck their soiled fingers. (2) By direct infection

Ways in which the expectoration carries infection.

with what has been termed the spray, produced when tuberculous persons cough violently or splutter whilst speaking.

With regard to infection through the sputum, it is obvious that the larger masses of the expectorated matter, unless they are collected in suitable receptacles or destroyed, must eventually mingle with the dust, whether they are *Infection through dust.* expectorated on to the ground, into a handkerchief, or elsewhere. Further, dust in places frequented by consumptive persons has been shown by numerous observers to be infectious. The best known of these experiments are those of Cornet, who, working under Koch's supervision, showed that dust, purposely collected from the wall *Infectivity of dust taken* behind the bed of a patient, or from the rails of the bed *from rooms.* behind the patient's head, so that there was little likelihood of direct infection by coughing, and dust from the tops of pictures, from cornices and from the floor, when injected into a guinea-pig, caused tuberculosis in many instances, unless strict precautions had been taken in dealing with the sputum. Of 118 dust samples taken from hospital wards or from the rooms of tuberculous individuals, 40 gave positive results, whilst in a room which had been occupied by a tuberculous patient the dust was shown to contain virulent bacilli six weeks after her death. Krüger, Kaster, and Biggs of New York, have obtained similar results. Coates of Manchester has shown that of dirty houses occupied by consumptive individuals at least 66 per cent. yielded infective dust, and that in the case of clean houses occupied by consumptives no less than 50 per cent. contained contaminated material.

Many observers have found the bacilli in dust col-

lected from other sources. Kirchner demonstrated the

Dust from other sources. presence of tubercle bacilli in the dust of the trousers and other clothes of soldiers in three out of six specimens examined. Petri demonstrated tubercle bacilli in the dust of the pillow, railing, and ceiling of a berth in a railway-carriage. Prausnitz also found them in the dust of a railway-carriage, and Hance has found them in trams.

Such dust may, as I have said, be introduced to the mouth by means of the finger, or the micro-organisms may be carried by the air to distant points, as has been shown by Neisser, who mixed tubercle bacilli with fine dust, and then directed a gentle current of air over the

Pulmonary tuberculosis experiment-ally produced by infected dust. mixture. Many experiments prove that this dust may cause pulmonary tuberculosis in human beings. Cornet showed some years back, as Tappeiner had shown before, that, if a moist spray of such dust were used, animals were readily infected. More recently he has been able to infect the lungs of guinea-pigs by means of *dried* tuber-culous sputum. He spread out human tuberculous sputum on the carpet of a room, mixed it with dust, and then allowed it to dry for two days. Guinea-pigs were placed on the floor and at varying heights. The floor was then

Distribution of the dust. swept with a stiff brush, and a cloud of dust raised. By this means, and by somewhat similar experiments, Cornet was able to infect forty-six out of forty-eight animals. Strauss and others, by placing plugs of cotton-wool in the nostrils of those engaged in hospital work, obtained virulent bacilli in nine out of twenty-nine instances. Finally, Spillmann and Haushalter have shown, by exten-sive experiments, that the common house-fly may become

the propagator of tuberculosis by acting as a carrier of tuberculous dust or sputum.

Many observations have been made which show that tuberculosis is specially apt to haunt certain houses, and the presumption is that the infection in these instances is conveyed by means of tuberculous dust. The following illustration is quoted from Dr. Percy Kidd's account of an instance observed by Engelmann : ' A newly-built flat in a fairly sanitary condition, but badly lighted and ventilated, had been occupied for eight years by three families in succession ; all of them had presented a clean list of health until the family X took up their residence in the same quarters. In this family the mother was consumptive when she came. She died in the flat. Shortly afterwards the family left, having lived there for one year only. The flat was next occupied by the family Y, of seven persons, all healthy. After a year's stay they left, and some years later the father, mother, and one son died of phthisis, and a boy of chronic peritonitis. A third family, Z, all healthy to begin with, next took the rooms. One child died of meningitis, another of marasmus, and a third contracted hip disease ; subsequently the father died of phthisis, another child of meningitis, the mother acquired consumption, and a child became scrofulous. A fourth healthy family, W, next came into residence. After a time the mother became phthisical, and two children died of meningitis.' During the whole period over which these observations range the flat was never empty and was never painted or cleaned. In other parts of the same building, which were properly cleaned, no case of tuberculosis occurred. One consumptive woman, there-

fore, by infecting a flat which was dirty and ill-ventilated, conveyed tuberculosis to at least thirteen individuals.

Infection by spray.

With regard to the distribution of tubercle bacilli by means of the minute fluid particles which may be projected from the mouths of tuberculous people when they cough, and in some instances when they speak, it has been shown by Fraenkel, and especially by Flügge and his pupils, that it is possible in certain instances to demonstrate the presence of tubercle bacilli in these small particles of phlegm.

Experiments with the Bacillus prodigiosus.

One of the first series of experiments in this direction was that of Weismayer, whose observations have been confirmed by Huebner. The latter observer gargled and rinsed his mouth with water containing the non-pathogenic *Bacillus prodigiosus.* He then placed some agar plates in front of him, and counted with a loud voice up to 375; 119 colonies of this micro-organism subsequently developed on the plates. On whispering up to 360, the number diminished to 17; and on speaking up to 551 in an ordinary tone, 41 colonies were obtained. Latschenko and Koeniger also experimented with cultures of the *Bacillus prodigiosus* placed in the mouth of human beings, and showed that contamination of the air took place, not only in front, but at the sides and behind the individual. In one instance Koeniger found that an entire room became infected by the spray of a single individual in two minutes, and that these organisms might remain in the air for one or two hours, whilst Flügge has found them in the air at the end of five hours.

Experiments with tubercle bacilli.

These experiments with a non-pathogenic organism suggested that tubercle bacilli might be distributed in a

similar manner, and Latschenko was able to demonstrate the presence of bacilli in particles which were produced by passing slow currents of air through tuberculous sputum. These particles were intercepted at a distance of 3 feet and then examined. Flügge and Latschenko requested some consumptive patients to cough, but not to expectorate, into a large glass box. The patients had to wear new rubber coats and rubber shoes, in order to avoid any sputum being detached from their clothes, and so leading to error. Sterilized glass plates, somewhat moistened, were previously placed in the upper portion of the glass box. After the patients had coughed, the expectorated material was scraped off the plates and inoculated into animals, all of which developed tuberculosis. Heymann investigated the spray produced by a consumptive individual under natural conditions, and found that the droplets were rarely projected for a greater distance than a metre. The average diameter of these droplets was 35 μ; they consisted of mucus, pus cells, epithelial cells, and numerous tubercle bacilli. According to Heymann, the bacilli may remain floating in the air for periods varying from fifteen minutes to an hour and a half. This observer also states that the particles on falling to the floor or furniture become dry, and that the micro-organisms then mix in the ordinary dust. He has further shown that the bacilli may live for two or three days, or, if they are in a dark and ill-ventilated position, for as long as eighteen days. Boston has obtained somewhat similar results. Moeller of Görbersdorf moistened pieces of glass with glycerine and gelatine, and suspended them over the beds of consumptive patients in all stages

Experiments with the spray of consumptive people.

for various intervals of time, and at all distances up to a metre. The pieces of glass were infected with bacilli in about 50 per cent. of the rooms. Analogous results have been obtained by Schaeffer in experiments in leprosy. This author found that lepers with leprous ulceration of the mouth and throat, after speaking for ten minutes, projected thousands, and in one case 180,000, of lepra bacilli upon the glass slides which were placed to intercept the moist particles.

Similar results in leprosy.

It has been proved, then, that tuberculous sputum is a source of danger, and that, under certain conditions, many tuberculous individuals when they cough, and in some instances when they speak, may project numerous moist particles, which are imperceptible to the naked eye, and which contain tubercle bacilli. After these particles have floated in the air for a varying time, they gravitate towards the ground, and, mingling with the dust, infect everything, such as furniture, books, and the like, upon which they happen to fall. Brehmer, indeed, held that this infection by dust was chiefly by means of the bedclothes, ordinary clothes, and, above all, by handkerchiefs. Every motion of the clothes causes little pieces of fibre and hair to break off, and, according to Brehmer, it is through this fine dust rather than the dried sputum on the floor, which breaks into larger fragments, that infection takes place. Further, Koch, Arthur Ransome, Cornil, and others, have demonstrated that under the influence of darkness, and in the absence of any movement in the air, the tubercle bacilli may thrive and remain virulent for many weeks, and even months, in the corners of the room, under beds, and behind articles of furniture, provided that the air contains

Conclusions as to methods of infection from human sources.

a sufficient quantity of aqueous vapour and organic matter. Ransome even asserts that tubercle bacilli will grow at the ordinary temperature on damp wallpaper.

Fortunately, the danger of infection in the ways just discussed, although it is very great unless proper precautions are taken, may readily be reduced to a minimum. The magnitude of the danger of infection by this means is not so great as has been thought, for many consumptive persons have no tubercle bacilli in their phlegm, and still more, have none in their saliva. Heymann has shown that for infection to take place directly from the spray of a consumptive individual, in contradistinction to the experiments with the *Bacillus prodigiosus*, a close proximity is essential, and that the infected particles are never projected beyond a distance of from 3 to 5 feet. It is obvious that even this distance can be materially reduced by the patient adopting the simple precaution of holding a handkerchief in front of his mouth when he coughs. *Danger of infection readily diminished.*

It is a well-known fact that tubercle bacilli are never found in the air where tuberculous people have not resided, and are seldom found in the air even of houses inhabited by consumptive people. Thus, Cornet and others have been unable to detect the bacilli in many public places, whilst Flügge states that the air of a tuberculous patient's bedroom can seldom be shown to be infectious, and that the floating dust to be dangerous must be present in clouds, as is the case, for example, in factories, or when rooms are swept. The explanation of some of these facts is simple, for it has been thoroughly established that free ventilation, even in the dark, has the power of arresting *Natural agencies destroy the bacilli.*

the virulence of the bacillus, provided there is no great excess of organic matter present. Diffuse daylight will cause the death of the bacilli, but this is most readily accomplished by free ventilation and direct sunlight. Ransome has shown that under the healthy condition of a dry, pure subsoil, good drainage, free ventilation, and plenty of sunlight, the bacilli lose their virulence so rapidly that tuberculous sputum may be no longer infective even before it becomes dry and is converted into dust.

Simple precautions prevent the spread of nfection.

Finally, the well-known observations and experiments in institutions for consumptive patients carried out by Cotton and Theodore Williams, Cornet, Heron, Hance, Achtermann, and others, have conclusively shown that the adoption of reasonable precautions, such as I shall presently describe, with regard to the disposal of the sputum, keeps the dust of these institutions free from tubercle bacilli, and practically does away with the possibility of any spread of infection. One or two examples will suffice : Hance, of the Adirondack Cottage Sanatorium, proved by inoculation experiments that sixteen out of seventeen cottages inhabited by consumptive patients were free from infective dust during as long a period as ten years. Achtermann for several years tested, by means of inoculation experiments, the dust from the corridors and rooms of the Brehmer Sanatorium. Only once did he find evidence of the existence of tubercle bacilli, and then in the neighbourhood of a sputum receptacle.

INFECTION BY MEANS OF FOOD.

Views hitherto accepted

Turning to the question of infection by means of foodstuffs, we find that, although Virchow and others were not

in favour of the theory, it was held until recently by nearly all authorities that the various types of tuberculosis, such as human, bovine, and avian, were merely different forms of one species, which owed their differences to the peculiarities of their environment, but which could be transformed under suitable conditions the one into the other. Consequently, most medical men believed that it was possible for human beings, and more especially children, to be infected with tuberculosis by the agency of food-stuffs. It was also generally held that the chief source of animal tuberculosis which was infective to man was cow's milk and butter, as it was known that 30 per cent. of all cattle were tuberculous, that some 3 per·cent. of all cows gave naked-eye evidence of tuberculosis of the udder, that many samples of milk contained millions of tubercle bacilli, and also that tubercle bacilli were excreted in the fæces of cattle, and could be conveyed to the milk in the form of dust. It was further generally agreed that meat infected with tuberculosis, or smeared with bacilli from other portions of the body during the ' dressing ' of the animal, might occasionally be the cause of tuberculosis in human beings.

In 1901 Koch and Schütz endeavoured to show that these views were unwarranted. Koch said that he was unable to infect cattle or pigs by means of tuberculous material taken from human sources, but that he could readily infect these animals with material taken from cattle. Koch therefore asserted that human tuberculosis is different from the bovine variety, and cannot be conveyed to cattle. He then pointed to the fact that primary tuberculosis of the intestines in children is very

Koch's views.

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rare, and asserted that without such primary lesions of the intestines we cannot trace any case of tuberculosis to infection by means of food-stuffs. He suggested that, as milk was in many cases swarming with tubercle bacilli, instances of primary tuberculosis of the intestines in human beings, whether in adults or in children, should be comparatively common if bovine bacilli were infectious to man. He then made the startling statement that the risk of infection by the milk and flesh of tuberculous cattle, and the butter made of their milk, is hardly greater than that of hereditary transmission, and that it is not advisable to take any measures against infection by this means.

Supported by Rokitansky's experiments.   These views of Koch are to some extent supported by the experiments made by Rokitansky twenty years ago, and recently published by Baumgarten. Rokitansky, who was under the impression, which has since been disproved, that tuberculosis and cancer could not co-exist in the same body, inoculated subcutaneously some halfdozen human beings, suffering from inoperable cancer, with considerable quantities of bacilli from a bovine source, which had proved highly virulent in the case of rabbits. In none of these patients was there any infection as the result of the inoculation, although most of them survived the inoculation for several months or a year. At the autopsies Baumgarten himself failed to find any tubercles or tubercle bacilli after the most critical macroscopical and microscopical examination of the lymph - glands adjacent to the point of inoculation, as well as of the tissues of the different organs.

Difficulties in accepting Koch's views.   On the other hand, Koch's views bristle with difficulties. They are, as Hueppe points out, in direct contradiction

to his former statements and experiments, so that 'after the most alarming warnings, based on the most searching scientific investigations, we receive the most assuring assertions also based on the most searching scientific investigations.'

The arguments against Koch's views may be briefly tabulated as follows :*

1. Human and bovine tubercle bacilli are identical in morphological, tinctorial, and cultural characteristics. [Similarity of bacilli.]

2. Although under ordinary circumstances there are marked anatomical differences between human tuber- [Anatomical differences of lesions caused not absolute.] culous lesions and the perle disease of cattle, yet the classical form of acute miliary tuberculosis can be pro- duced in cattle by infection with bovine bacilli, whilst Tangle and Troje have shown that the human type of bacillus can be so modified in its pathogenic power by certain external influences, such as iodoform vapour, that it will produce the typical form of perle disease in rabbits.

3. Tuberculin produces the same specific reaction in [Tuberculin.] tuberculous cattle, whether human or bovine bacilli have been employed in its preparation.

4. It has been proved again and again that tubercle bacilli may pass through a mucous membrane without [Bacilli do not always cause disease at point of entrance.] leaving any trace at the point of entrance; in other words, we may have infection through the food-stuffs without a primary intestinal lesion.

5. Woodhead, Martin, and others, have shown that in- fection by means of food may primarily take place through [Food may infect tonsils.] the tonsils. Koch himself found that this happened in

* For further details, see the author's article on 'Some Points in the Etiology of Tuberculosis' (*Edin. Med. Jour.*, November, 1902).

the case of one of his pigs. A primary lesion of the intestine is not necessary, therefore, for the transmission of infection by food-stuffs.

6. Nearly all observers are agreed that if the oldest tuberculous lesion in the lymph-glands is taken as a guide Pathological evidence in children. to the source of infection, not less than 25 to 30 per cent. of the cases of tuberculosis which occur in early childhood are due to intestinal, and therefore presumably food, infection.

7. It is a striking fact that the curve of the incidence of tuberculosis in children commences at the age of six months, and falls almost by crisis between the third and Children infected during milk life. fourth years—that is to say, tuberculosis is most marked at an age when infected milk would be taken most freely, and that it becomes less frequent as children begin to leave what may be called their milk life. We must, however, remember that some authorities attribute this incidence of tuberculosis in childhood to the children playing on their hands and knees, and so conveying the infectious material to their mouths by means of their fingers.

Human tuberculosis successfully transmitted to cattle. 8. Other observers, such as Bollinger, Crookshank, Martin, and Ravenel, have successfully transmitted tuberculosis from human sources to cattle.

Infection of human beings from tuberculous cattle. 9. Many undoubted cases of infection of human beings from tuberculous cattle have been recorded by authors such as Ravenel, Tscherning, Pfeiffer, and Hartzell. An instructive case, published by Professor Johne, of Dresden, may be quoted. A veterinary surgeon inoculated his thumb while dissecting a tuberculous cow. Six months afterwards tuberculosis of the skin manifested itself in the scar of the wound, and later on pulmonary symptoms

developed, together with expectoration of tubercle bacilli. The patient died, and at the post-mortem examination a considerable number of tubercle bacilli were found in the thumb-joint, which appeared to be in all respects similar to those expectorated during life.

10. Dinwiddie, Ravenel, and others, have shown that bovine tuberculosis is the most virulent of the various forms, and that it is possible to infect all domesticated animals by means of bovine tubercle bacilli. It would indeed be strange if human beings were unique amongst domesticated animals, and that they alone were immune to bovine tuberculosis, as, though there are exceptions, it may be taken as a law that when the virulence of a pathogenic organism is increased for one animal, it is increased for all that are naturally susceptible to its action.

Koch has recently announced that further experiments made on his behalf have confirmed the experiments on which he based his views. The English Royal Commissioners, on the other hand, have made two interim reports to the effect that it is possible to inoculate cattle with human tuberculosis.

We may allow that Koch has shown that human tubercle bacilli are less virulent than those derived from bovine sources, but we are forced to conclude, more especially in view of the second interim report of the English Royal Commission, which has been published as these pages are passing through the press, that tubercle bacilli derived from cow's milk and other animal sources convey the infection to man. It is, therefore, imperative for us to take every precaution which may prevent either healthy human beings or those already afflicted with tuber-

Bovine tuberculosis virulent for all other domesticated animals.

Conclusions.

culosis from consuming food contaminated with tubercle bacilli. Fortunately, we may readily avoid any risk of infection by adopting the simple measures which I shall shortly mention.

It is easy to see from the previous pages the various ways in which tubercle bacilli contained in sputum or spray, or in milk or other articles of diet, may reach the mouth or nose of a fresh host. What happens to them then ? In some cases they are destroyed by the various protecting agencies of the human body ; in others they cause infection, which may be of various types, according to the virulence of the particular bacilli. We have no exact information as to the way in which the bacilli then reach the lungs ; it may be by the inhaled air, or by the lymphatics, or by means of the blood-stream.* There is some evidence to show that tubercle bacilli can seldom penetrate through the nasal passages, and consequently it is probable that in most cases the bacilli gain entrance to the body by means of the mouth. Hildebrandt proved that the air is entirely freed from' germs of all kinds before it reaches the trachea in the case of nose-breathers,

and Thomson and Hewlett have demonstrated, by an ingenious experiment, that, owing to the filtration and other processes which occur in the healthy nose, no micro-organisms are to be found in the air respired through this organ by the time it reaches the pharynx, although the number of germs inhaled may be as many as 10,000 per hour. When the bacilli have reached the mouth, it is probable that, if they are present in sufficient force and possess a sufficient degree of virulence, they can

* For further information on this point, see *Edin. Med. Jour.*, *loc. cit*

set up tuberculosis in any man, no matter what his con-
dition of health may be. If the number is small, or the
virulence of the bacilli is not marked, then the question
whether infection takes place or not—that is, whether
the bacilli or tissues prove victorious—depends on what
we may term the conditions of a man's health.

It is generally accepted that tubercle bacilli in small
numbers are harmless to those who are in a good condi-
tion of health. We do not know the reason of this, but The question
it would appear that the susceptibility to tuberculosis of resistance.
depends upon some inherited qualities, or on some subtle
chemico-physiological variations from the normal condi-
tions of the body cells and fluids which are vaguely ex-
pressed by the phrases 'suitability of the soil' or 'diminu-
tion in bodily resistance.' The former I shall discuss
in connection with the question whether tuberculous
people should be allowed to marry, but in order to under-
stand the conditions under the which reinfection of an
individual, who has already contracted tuberculosis, may
occur, we must consider what circumstances may diminish
the bodily resistance sufficiently to allow infection to take
place.

One man's resistance may be much greater than
another's, and what will break down the forces opposed to
the bacilli in one individual need not do so of necessity in
another, so that we can only form a general idea of the
lines on which the resistance of healthy people may be
overcome. We can, however, learn valuable lessons in
the treatment of those already afflicted with consumption
from a consideration of this subject. Anything which
weakens a man makes him more liable to become in-

Conditions
which lower
the resist-
ance.

fected with tuberculosis. We know, for example, that in many debilitating diseases, such as diabetes, tuberculosis frequently occurs; that certain acute diseases, more especially in children, such as measles, predispose to it; and that habitual drunkards are prone to contract the disease, and, having contracted it, readily succumb to its ravages. Again, long before tuberculous disease was regarded as infectious, evidence was being accumulated to show that bad sanitary conditions, such as absence of sunlight or ventilation, bad drainage, and polluted subsoil, together with an insufficient supply of food, were the chief predisposing causes of consumption. 'Where the sun and air do not enter, the physician enters often,' is an old Persian proverb, whilst the sanitary records of the last sixty years, and the extraordinary diminution in the rate of the mortality from tuberculosis which has followed the adoption of better sanitary conditions, prove that close confinement and bad ventilation are among the most important factors in the etiology of tuberculosis. The fact that insufficient or non-nutritious food plays an important part in the etiology of tuberculosis is based on our knowledge of the etiology of nearly all infectious or contagious diseases.

Effect of
confinement.

One or two examples of the effect of confinement and bad ventilation will suffice. Cornet, in investigating the statistics of the mortality of tuberculosis in females, came to the conclusion that, in sisterhoods where bad sanitary conditions are present, a healthy girl entering at seventeen dies 21·5 years earlier than her sister who belongs to the general population of the State; that such an inmate in her twenty-fifth year has the same expectation of life as a female of the outer world at the age of forty-

five, and that a nun of thirty-three must be classed with a female outside at the age of sixty-two. The same is true of animals, as Sir F. Fitz-Wygram showed in connection with the London cab-horse, and as is well exemplified by the fact that, whilst horses at one time died in large numbers from tuberculosis in the London Wellington Barracks owing to bad ventilation, yet very few died in the Crimea from this cause, although constantly exposed to the effects of a rigorous climate.

The bad effect of close confinement and insufficient ventilation is due to the impurity of the air, to what has been called air-sewage. Ehrenberg and many others have shown that an enormous quantity of floating matter exists in impure air, and Pasteur laid it down as a law that air to be pure must be free from both organic and inorganic floating matter. Haldane and Lorrain Smith have proved that in respired air the only deleterious substance, apart from micro-organisms, is carbon dioxide gas. It is an established fact that, when this gas becomes appreciably increased over its percentage in the outside air, the health suffers, and the resistance of the body is impaired. In addition to the excess of carbon dioxide present in the air of badly-ventilated rooms, we have the organic matter contained in the various forms of dust, the sulphuretted hydrogen and other gases given off from drains, from kitchen traps, and insufficient coal decomposition. Further, a number of micro-organisms are constantly to be found in this air, many of which, such as the varieties of streptococci, not only lead directly to disease, but are the cause of streptococcic or secondary infection in tuberculosis.

The cause of this.

Conclusions.   I have said enough to show that, in order to avoid tuberculosis, we must avoid any debilitating conditions, and especially bad surroundings, for it is now regarded as a law that, where there is a high mortality from tuberculosis, the sanitary conditions are imperfect. I would insist that one of the most powerful predisposing causes of tuberculosis is foul air, and that, as Lord Beaconsfield once said, the atmosphere in which we live has more to do with human happiness than all the accidents of fortune and all the acts of Government.

From a study, then, of the etiology of tuberculosis, we see that, if we are to ward off fresh infection, we must not only utilize every means for the ready destruction of the tubercle bacillus itself, but do everything in our power to preserve and strengthen the resistance of our patients to the inroads of this micro-organism.

The Measures to be adopted in dealing with the Tubercle Bacilli.

In the succeeding chapter I deal more fully with the question of preserving and strengthening the resistance of our patients, and shall now detail, as briefly as possible, the methods which may be adopted to destroy the tubercle bacilli, and prevent them from carrying infection.

Sputum receptacles and sputum.   1. When in their rooms patients should have receptacles, made of papier-mâché or of aluminium, conveniently placed to receive their expectoration. The top must be so constructed that flies cannot disseminate the sputum. Such cups are cheap, and are already in use at a number of sanatoria. The cups should be filled to one-third with a mixture of lysol and soap, as this tends to

mitigate the repulsive appearance of the sputum, and to prevent drying and dissemination, whilst Gerlach and Spengler have shown that lysol effectively diminishes the virulence of the tubercle bacilli.

When patients are out of their rooms they should expectorate into a Dettweiler, Guelpa, or other flask, or similar contrivance which can readily be hidden in the folds of the handkerchief and which cannot spill its contents.

Many observers have held that it is impossible to sterilize tuberculous sputum by boiling; but Dr. Marcus S. Paterson has shown conclusively that articles infected with the tubercle bacillus are rendered sterile at a temperature of 100° C. From this it follows that any articles infected with tubercle bacilli may be rendered sterile with certainty by boiling them in water for half an hour under atmospheric pressure. The addition to the water of sodium bicarbonate is of value, as it raises the boiling-point to 102° C. If steam under pressure be used, the time may be shortened. Delépine states that a 2 per cent. solution of chlorinated lime efficiently destroys tubercle bacilli when mixed with an equal quantity of sputum. The only practical methods, then, by which we can destroy the larger masses of sputum are either by incineration, boiling in water for half an hour, or by using chlorinated lime. The contents of the flasks should be mixed with sawdust in an iron receptacle and then burnt, or the contents may be boiled in water for half an hour and then poured down the drain. The flasks themselves should be placed in a copper containing water to which sufficient washing soda has been added to make it strongly alkaline;

the water should be gradually raised to the boiling-point and kept there for thirty minutes. The flasks should then be washed out with water and stored for use.

The hands, beard, and hair should be kept scrupulously clean, and the patients should be instructed always to place a handkerchief in front of the mouth when they cough, and never to expectorate anywhere except into some form of flask or other receptacle. Patients should be instructed to avoid the act of coughing as far as possible. It is remarkable to what an extent the act of coughing in a tuberculous individual depends on habit. A few days of judicious restraint of the inclination to cough, in many instances, is of great value, and leads to a permanent Patients diminution in the inclination to this act. Fortunately, must learn not to cough. most patients rapidly lose their cough under open-air treatment, although they continue to get rid of a certain amount of expectoration. Further, in view of the numerous observations of the infectivity of spray from the mouth made by Heymann, Flügge, Boston, Nenninger and others, to which I have referred, it is imperative that consumptive patients should take the most scrupulous pains with regard to the cleanliness of their mouths.

Handkerchiefs. Handkerchiefs must not be used to spit into, but only to wipe the mouth, and they should be carried in a special pocket, backed with an indiarubber or oil-silk detachable lining, which can be disinfected readily, for, as y Capo has said, the pocket which contains a handkerchief soiled, it may be, with mucus, sweat, or saliva, forms a veritable breeding - ground for many forms of micro - organisms. Handkerchiefs and napkins made of Japanese paper, or of some material such as calico strips, are useful, as they are

cheap and can be burnt. As paper handkerchiefs and napkins are not pleasant things, patients may be allowed ordinary handkerchiefs, provided that they are changed frequently, and linen napkins, if clean at every meal. Ordinary handkerchiefs after use should be placed in water to which soda has been added. They should be allowed to soak thoroughly, and may then be disinfected by boiling in water for half an hour, or by being subjected to steam under pressure for a shorter time.

2. All cleansing of the walls and floors must be carried out by wet cloths, as other methods do not remove the dust, but simply displace it. It has been said that the sound of the brush or broom should no more be heard in a sanatorium than was the hammer within the sacred precincts during the building of Solomon's Temple. The floors and the lower 3 feet of the walls may be wiped daily with a damp duster, moistened with a solution of 1 in 100 of chlorinated lime. Floors may be subsequently polished. The dusters must be periodically burnt. The researches of many observers have proved that walls above the height of 3 feet are extremely unlikely to be infected, provided the patient is properly educated in dealing with his sputum. A periodical thorough scrubbing with soap and water has been shown in many hospitals to be all that is required. The walls should be frequently repapered or distempered. They should also be disinfected from time to time with formaldehyde—generated in a suitable apparatus—as an additional precaution. *The walls and floor of the room and passages.*

3. The furniture should be well wiped with a duster, *Furniture.* moistened with a solution of 1 in 100 chlorinated lime. This agent does not injure furniture if the latter is subse-

quently wiped with a duster moistened in water. The furniture should be of such a nature that but little dust collects, and of such materials that it is readily disinfected. For example, most forms of stuffing or of carpet cannot be dealt with satisfactorily, and leather is readily injured in the process. On the other hand, linen covers, washable leather, and wickerwork, may readily be disinfected.

Linen.

4. The linen covers of couches and the like should be collected in suitable receptacles, then thoroughly soaked in cold water, in order to remove various stains which treatment with steam tends to fix, and subsequently sterilized by means of steam in the laundry.

Ordinary clothes.

5. Ordinary clothes, small mats, wicker-chairs, mattresses—which should be made so that they may be unpicked readily—and other similar articles, may be efficiently disinfected in the disinfecting-stations which are now erected in most towns.

Articles which cannot be sterilized by steam.

6. Such articles as books, leather, wool, silks, brushes, combs, and other articles which are damaged when sterilized by heat, may be treated with formaldehyde (for method see Appendix, p. 245).

Crockery, knives and forks.

7. Crockery, knives and forks, etc., can be sterilized in an ordinary surgical sterilizer by gradually raising the water, to which sodium bicarbonate has been added, to a temperature of 102° C., and then keeping it at this temperature for at least twenty minutes.

Old articles, dust, and refuse.

8. Infected rags, paper, old mattresses, pillows, dusters, etc., which are no longer required, together with the various forms of dust and refuse, should be burnt. The dust receptacles may be sterilized by heat,

Bedroom and other slops.

9. Bedroom and other slops probably do not require to

be disinfected ; at most the various utensils may be periodically scalded.

10. Cooking affords a simple means of rendering meat Food-stuffs. and other articles of food sterile. Milk should be sterile, and free from tubercle bacilli. English people are the only civilized people, according to Sir R. Thorne Thorne, who habitually consume uncooked milk, because they have a rooted objection to it when boiled or scalded. Consequently, the milk used should be obtained, if possible, from healthy cows which are certified not to be tuberculous. If there is any difficulty in obtaining a supply which is certified by a competent veterinary surgeon to be free from tubercle bacilli, the precautions recommended by the National Association for the Prevention of Consumption may be adopted : '(1) Use a double Method of sterilizing milk saucepan ; if, however, this cannot be obtained, put milk. the milk into an ordinary covered saucepan, and place it inside a larger vessel containing water. (2) Let the water in the outer pan be cold when placed on the fire. (3) Bring the water up to the boil, and maintain it at this point for four minutes without removing the lid of the inner milk-pan. (4) Cool the milk down quickly by placing the inner pan in one or two changes of cold water without removing the lid. (5) When cooled down, aerate the milk by stirring well with a spoon.'

When treated in this way milk is rendered perfectly harmless,* whilst the cooked flavour, objected to by many individuals, will be found to be comparatively slight, and the formation of surface scum is practically prevented.

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* No 'milk sterilizer' should be regarded as efficient which is incapable of maintaining its contents at a temperature of 185° F. for five minutes.

CHAPTER V

THE PRINCIPLES OF THE OPEN-AIR METHOD OF TREATMENT AS CARRIED OUT IN A SANATORIUM

TWENTY-FIVE centuries ago Hippocrates wrote that tuber-
culosis was a curable affection, provided that it was
treated at a sufficiently early stage. Many of the ancient
authors, such as Celsus, Pliny, and Galen, expressed
similar opinions, and insisted on the importance of a
suitable climate and good living. It was left, however, to
a Scotch physician in 1747, when writing to his London
friends, to assert for the first time in clear and unmistak-
able language, supported by the incontestable evidence of
the results he had obtained, that hygiene and diet are the
most important factors in the treatment of tuberculosis,
and that climate and medicine are only to be considered
as more or less precious adjuvants. The practical out-
come of this teaching was not encouraging, and until
some fifty years ago both the public and the overwhelming
majority of the medical profession regarded tuberculosis
as an incurable disease. So much was this the case that
Sir Thomas Young, writing in 1815, said : 'Even with
the utmost powers of art perhaps not more than one in a
hundred will be found curable'; whilst Ullesperger called
attention in 1867 to the fact that up to that time barely

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200 cases of cured, or what we should term arrested, tuberculosis were to be found in medical as distinct from pathological literature. A French writer took a somewhat more hopeful view when he said : 'There are two kinds of consumption—that of the rich, which is sometimes, and that of the poor, which is never, cured.' The principles announced by the Scotch physician were not readily appreciated, and were seldom put into practice, the efforts of medical men of that day being directed towards the comfort of their patients rather than towards the arrest of the disease. Thus, every tuberculous individual, and even those who were regarded as being likely to contract the disorder, was wrapped up in heavy clothes, kept in a hot-house atmosphere, and jealousy guarded against exposure to the fresh air.

The great additions to our knowledge of the pathology of tuberculosis which originated in the genius of Laennec Laennec. paved the way for the radical alteration of the views held by the majority of physicians with regard to the cura-bility and treatment of the disease. This was chiefly brought about by the teaching of Carswell, who wrote in Carswell. 1836 : ' Pathological anatomy has never afforded stronger evidence of the curability of a disease than in the case of phthisis.' This opinion has been supported by every subsequent observer. That this view was able to gain ground as rapidly as it did was due in no small measure to the establishment in England of special consumption hospitals—namely, the Royal Sea-Bathing Infirmary for Scrofula, at Margate, in 1791 ; the Royal Hospital for Diseases of the Chest, in London, in 1814 ; and the Brompton Hospital for Consumption, in 1841. Further

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progress towards the true conception of tuberculosis was made by Pasteur's creation of the new science of bacteriology; by Villemin's demonstration, in 1865, of the fact that the disease can be transferred to animals by means of inoculation; by Koch's announcement, in 1882, of his memorable discovery that tuberculosis is an infective disease, and depends for its inception upon a bacillus; and, finally, by Sir John Simon's classification, in 1887, of tuberculosis as a filth disease.

The advance of our pathological knowledge during recent years has made it possible to formulate the real principles upon which the treatment of this disease should be based; but we owe a deep debt of gratitude to those members of the medical profession who from time to time during the last century made an effort, in spite of the contumely poured upon them by their fellow-practitioners, to carry on the treatment on the basis we now adopt. In 1840 George Bodington, of Sutton Coldfield, Warwickshire, wrote an essay 'On the Cure of Pulmonary Consumption on Principles Natural, Rational, and Successful,' in which he insisted on the importance of a generous diet, fresh air day and night, 'together with systematic arrangements with regard to exercise and general treatment, and the watchfulness daily—nay, almost hourly—over a patient by a medical superintendent.' Bodington emphasizes his views of the necessity of a continuous supply of fresh air by this sentence: 'Cold is never too intense for a consumptive patient; the apartment should be kept well aired, so that it should resemble the pure air of the outside, pure air being used in the treatment as much as possible.' This author met with

the most bitter and contemptuous treatment, being re-
garded as a lunatic; his patients were driven from his
institution, which, by the irony of fate, he was compelled
to turn into an asylum for the reception of the insane.
His sanatorium was the first of its kind in the world, and
within its walls for several years previous to the publica-
tion of his essay Bodington had practised his principles
and effected many cures.   In 1855 Dr. Henry McCormac, McCormac.
of Belfast, published a book on somewhat similar lines,
and as a result had to bear every kind of persecution to
which a man in his position could be subjected.   In 1861
he read before a distinguished medical society in London
a paper on 'The Absolute Preventability of Consumption,'
in which he advocated what are now established prin-
ciples.   Practically the same doctrine was preached at
this time by Dr. Bennett of Mentone, and by the late
Sir Benjamin Ward Richardson, who embodied his views
in a pamphlet called 'A Sanitary Decalogue.'   The
man, however, who must be regarded as the founder of
the sanatorium treatment of tuberculosis is Hermann Hermann
Brehmer, for he persisted, in spite of fierce opposi- Brehmer.
tion and abuse, with his methods, which were more
systematic and thorough than those of his predecessors,
and he finally convinced the world of their soundness and
importance.   Brehmer's thesis for his doctor's degree in
1856, 'Tuberculosis primis in stadiis semper curabilis,'
was characteristic of his life's work.   In 1859 he was
permitted, owing to the influence of his friends Humboldt
and Schönlein, to open a sanatorium at Görbersdorf, and
in 1886 he published his well-known book.

General acceptance of Brehmer's views did not come

at once; indeed, some of the grounds upon which they were based have since been shown to be erroneous. His supporters met with little encouragement, and not infrequently with reproach. But it is owing to them—to such men as Otto Walther of Nordrach, and Rhoden in Germany, Sir Hermann Weber and Dr. Kingston-Fowler in England, Blake and E. L. Trudeau in the United States of America—that we have at last come to regard the open-air sanatorium treatment as the best remedy for tuberculosis.

In my opinion all patients with consumption, unless their condition contra-indicates it (see p. 224), should go to a sanatorium at the commencement of their treatment, as in this way they learn the necessary principles and routine far better than at home, whilst the sight of others, formerly in a worse condition than themselves, making rapid progress towards recovery tends to encourage hope. In this chapter, therefore, I shall deal with the principles of treatment as carried out at open-air sanatoria.

Brehmer's views.

Brehmer held that tuberculosis was an infectious disorder, but that certain conditions, more especially a small heart, made people much more liable to it. He noticed that at Görbersdorf there was hardly any tuberculous disease, and that the inhabitants had particularly powerful hearts. These facts, he thought, were due to the air-pressure at the altitude of that place. He not only adopted Küchenmeister's theory that tuberculous disease did not exist above a certain altitude, which increased as the Equator was approached, but supposed that the diminution of the air-pressure increased the power of the heart, and so lessened the liability towards tuberculous infection. His next step marked a great advance, for

Brehmer argued that 'anything which protects one man from falling ill must be able, if properly employed, to cure another of the same disease,' and from this argument he evolved the modern treatment of tuberculosis on the following lines:

(*a*) A life spent in the open air under conditions which give immunity from tuberculosis.

The essential principles of Brehmer's treatment.

(*b*) Complete freedom from any debilitating circumstances, or anything which may lead to an exacerbation of the disease.

(*c*) Methodical hill-climbing as an exercise when the condition of the patient renders this advisable.

(*d*) Constant and unremitting medical supervision.

(*e*) An abundant dietary, in which milk, fatty food, and vegetables occupy an important place.

(*f*) Various hydro-therapeutic measures.

Brehmer also insisted on the necessity of providing facilities both for observation and research.

These headings might stand fairly enough to-day. In the nature of things they tend to overlap one another, but it will probably conduce to brevity if I discuss them separately.

Consideration of Brehmer's essentials.

1. A LIFE SPENT IN THE OPEN AIR UNDER CONDITIONS WHICH GIVE IMMUNITY FROM TUBERCULOSIS.

The idea that at a certain altitude there exists a zone free from tubercle bacilli was shown by Dettweiler and others to be erroneous, for tuberculous disease was found to be rife amongst the watchmakers in the high Alps. On the other hand, it does not exist in the Khirjis Steppes, which

Conditions for immunity.

are below the sea-level, nor in the low-lying portions of Iceland. The keynote of Brehmer's treatment, however, was not the question of the altitude or climate, but the conditions which insure exemption from tubercle. He was wrong in thinking that these conditions could only be obtained at high altitudes. In fact, experience, as formulated more especially by Finkelnburg, has shown that the really essential climatic conditions for sanatorium treatment are an elevated and sloping site, with a sunny exposure, well sheltered from cold winds, a dry and permeable soil, and an abundant supply of water. Brehmer was right, however, in thinking that tuberculosis could only be dealt with satisfactorily when the conditions in which the patient lives are identical with those which have kept others free from the disease. In 1855, when he first acted on the above ideas, our pathological knowledge on the subject was far from perfect, and he could not have had exact information with regard to the etiology of tuberculosis. Owing to the rapid strides made by pathology and bacteriology, and especially to the discovery in 1882 by Koch of the tubercle bacillus, our knowledge to-day, though still imperfect, is much more

Conditions for infection.

exact and extensive. We have seen in the preceding chapter that tuberculosis depends upon infection with the tubercle bacillus, and that this does not and cannot take place unless a man happens to be susceptible; or, if we put it in other words, unless what we call—for want of a better term—his vitality has been so lowered by his surroundings, by disease, or by the quality and quantity of his food, that he is powerless to resist infection although previously immune. Anyone who has contracted tuber-

culosis shows thereby that his resistance has been lowered, and that it is necessary for him to be protected from any source of further infection, more especially as we have no guarantee that he may not be further infected by tubercle bacilli of greater virulence than those which have already obtained a hold upon him. It has been clearly shown of late years that the form of treatment which does this most effectually, in the greater number of cases, is that carried out in a sanatorium conducted on open-air lines.

It has already been pointed out that the chief source of infection, apart from the question of infection by milk and food, is dust which has been infected by tubercle bacilli. It is clear that those precautions, such as the collection and destruction of sputum, which have proved efficacious in preventing the dust from becoming infected, must be adopted in any place where the treatment of tuberculosis is carried on. As, however, patients may in an unguarded moment, or from neglect or accident, disseminate the bacilli, rooms occupied by tuberculous individuals should be constructed and equipped in such a way that the dust which inevitably collects can be readily removed. Further, every precaution should be taken against the formation of dust anywhere in the vicinity of a sanatorium, not only because such dust may become infective, but because both dust and organic effluvia lead to bad results. The former excites useless cough and irritates the air-passages, whilst the latter lowers the constitutional vitality, and, as we have seen, fosters the growth of the tubercle bacillus. The grounds in the neighbourhood, therefore, should be laid out in such a

How to avoid infection.

way as to minimize the possibility of dust being carried by the winds. Again, coal—that most potent factor in the formation of dust—should be used as sparingly as possible, and, if used at all, should be consumed as completely as may be, whilst the buildings occupied by the patients should be well removed from roads and from human traffic.

It has been shown in the last chapter that the most powerful predisposing cause of tuberculosis is foul air; consequently, in the treatment of consumption our first endeavour must be to insure that our patients continually *Necessity for pure air.* live in a pure atmosphere. Numerous observations by Angus Smith, Pettenkofer, and Moeller, have proved that it is very difficult to maintain the ventilation of any building at such a pitch that the air contained in it has the same composition as pure outside air. Pettenkofer, in his work on this subject, has shown that in the open air 324,000 cubic feet of air pass over an individual in an hour under ordinary conditions, and that we cannot approach this *Ozone.* amount in any building. Again, ozone is only obtained in the outside atmosphere. Many virtues are attributed by some authorities to this gas, but it is doubtful whether its presence has any value, save as an index of atmospheric purity. In any case, Delépine has shown that ozone has no effect upon the virulence or life of the tubercle bacillus. Free ventilation and direct sunlight are the most potent and efficient agents at our disposal for the destruction of the micro-organisms. Foul air favours their growth, and also lowers our powers of resistance.

Our first aim must be to provide such ventilation that the air contained within buildings occupied by consump-

tive patients does not essentially differ from the outside
air. It has, indeed, been said that it is as unreasonable
to ask people to breathe air which has already been re-
spired and contaminated, as to ask them to wash in water
already used by others.

It is clear, then, that the best conditions not only for Beneficial
preserving and strengthening the resistance of the body to effects of an
the inroads of the bacillus, but for the ready destruction of open-air life.
the tubercle bacillus itself, are obtained by an open-air life.
Further, an open-air life must do much to starve out
those micro-organisms, such as streptococci, which so
materially assist the tubercle bacilli. Brehmer, following
in Bodington's footsteps, grasped this truth before Koch
demonstrated the infective nature of the disease, and, as
he argued that the circumstances which keep a man free
from tuberculosis must be the ideal ones for those already
afflicted, he insisted on the importance of consumptive
individuals, and others suffering from tuberculosis, living
as far as possible in the open air.

The great objection to Brehmer's view, which was Exposure no
raised by medical men in his own time, and, indeed, by drawback.
many at the present day, was that patients, especially
delicate consumptive patients, could not stand the necessary
exposure. It had, however, long been known that tuber-
culosis runs a relatively rapid course in warm climates,
and that patients, who gained weight and improved in
health during the winter, lost ground as soon as the
warmer weather set in. The health resorts which were
most successful in the treatment of consumption, almost
without exception, had been places which were cold, or
at all events cool, during some part of the twenty-four

hours.   These facts, and the knowledge that animals with
incipient tuberculosis recovered if they led an open-air
life, whereas they died if kept to the house, furnished
strong support to Brehmer's views.   Our experience for
the last forty years has done much to strengthen the
position taken up by him.   It has been shown that no
amount of exposure to wet, nor any variation of tempera-
ture, causes the most delicate patient to contract what is
termed a chill, or to suffer any other harm, so long as an
open-air life is led and the exposure is constant.   If
patients are well nourished, sufficiently clothed and
sheltered from the wind, any degree of cold may be defied.
At Falkenstein, for example, patients lie out of doors for
many hours during thick fog and snow-storms, and when
the temperature is $10°$ to $12°$ C. below freezing-point.
Blumenfeld made an elaborate investigation of the harm-
ful effects due to the meteorological conditions at Falken-
stein.   He found that injurious results only occurred when
north-east winds were prevalent; and Andrord at Ton-
saarsen, Norway, kept patients five to nine hours a day
in the open air, at a temperature of $-25°$ C., without any
bad effect.   The same extreme cold is safely endured at
the Sharon Sanatorium, near Boston, and the Chestnut
Hill Hospital, near Philadelphia.

Were fine weather and freedom from exposure a *sine
quâ non*, the remarkable success of the sanatoria in the
Black Forest, more especially of the Nordrach Colonie,
and the favourable results recorded by Josselin de Jong,
with regard to low-lying districts in Holland, would never
have been chronicled.   The sanatoria of the Black Forest
have a moist and chilly climate for a great part of the

year ; patients do at least as well at such seasons as in finer weather. Indeed, the results of treatment are better in winter than in summer. This was pointed out by Grabilowitsch of Halila, and has been confirmed by many Continental authorities. No one, indeed, claims to have obtained better results in summer. From personal experience I know that this is true not only of foreign sanatoria, but of sanatoria in England, where in many cases the results are better in the winter months than in summer. At some institutions, such as the Victoria Hospital, Edinburgh, and the Hospital at Bridge of Weir, in Scotland, heated air was first employed ; after a fair trial of this method, Brehmer's plan of constant exposure to the temperature of the outside air was adopted, and much better results were obtained. It has been found that patients readily become acclimatized to exposure—in fact, the circulation in their extremities is so much improved after a week or two in an efficient sanatorium, that they cease to ask for hot bottles for their feet, whilst they develop such an 'air hunger' that they refuse to go into rooms in which the windows are not kept constantly open. Two further great advantages of open-air life are the remarkable way in which it stimulates the capricious appetites of the patients, and the beneficial effect it exercises upon the various forms of distressing cough.

It has been asserted that patients may lose their tuberculosis in this way, only to contract rheumatism. A personal experience may be of interest on this point. I used to suffer so frequently from rheumatic pains that I took great care to avoid any possible draught, and to keep as far as possible at the same temperature. Some years ago I had

Exposure, when constant, does not lead to rheumatism.

occasion to spend a few weeks at Nordrach Colonie at
a most inclement season. I followed the routine of the
patients, and sat, often for hours, bare-headed and with
no greatcoat, amidst the snow. I felt so much better in
health that, on returning to my ordinary life, I adhered
to the Nordrach methods to a large extent, and, as a
result, have since been stronger and absolutely free from
rheumatism.

We may say, then, that there is no danger from *constant*
exposure. The consumptive patient needs pure air in all
its natural simplicity; he must live in it, bathe in it con-
tinually. Discrimination must naturally be used. Thus,
Conditions
for exposure.
many patients, especially those with extensive disease,
cannot stand exposure to wind, and what is good at
twenty-five years of age is not necessarily good at fifty-
five. When the weather is cold the rooms occupied
by tuberculous patients may be slightly heated, and
an attendant, on calling the patient in the morning,
may close the window for him, so that he may avoid
the unpleasantness of getting out of a warm bed and dress-
ing in a chilly atmosphere. The attendant may also close
the window in cold weather before the patient returns
from his walk, and at bedtime, and thus warm the room;
but the patient must invariably open the window when he
comes in, for his life, not only when in the sanatorium,
but for ever afterwards, depends upon his being hardened
and upon his becoming habituated to an open-air life and
to every degree of inclemency.

Conclusions.   It has been shown, then, that exposure to severe
climatic conditions is, with certain limits, no drawback to
the open-air treatment of consumption, and that pure air

is, both from the point of view of prophylaxis and of treatment, of the utmost importance. In what way may the air become contaminated? We have already seen that overcrowding, insufficient sunlight and ventilation, are the most potent factors. Therefore, buildings which are occupied by tuberculous individuals must, as we have seen, be so constructed that the atmosphere within them rivals the outside air in point of purity. For example, a smell of cooking may destroy the appetite of an individual, while fresh air stimulates it: consequently, great pains must be taken to completely shut off the dining and kitchen arrangements from the patient's rooms. Again, though it may be possible to keep a room where a single patient lies fairly free from impurity, the atmosphere of any room in which a number of persons have gathered together for any length of time will certainly become more or less contaminated, and on this account alone it is obvious that the use of recreation-rooms or other places of assembly, such as concert-rooms or churches, must be restricted within narrow limits. Finally, the sanitation must be perfect and without flaw.

2. COMPLETE FREEDOM FROM ANY DEBILITATING CIRCUMSTANCES OR ANYTHING WHICH MAY LEAD TO AN EXACERBATION OF THE DISEASE.

We have seen that, even in health, various circumstances may lower the resistance of the body, and it is obvious that, in the case of a man who is already debilitated by the ravages of tuberculosis, many things which in health are possibly of little importance may cause a further loss of resistance, and so lead to an exacerbation of the disease.

Consumption is a febrile disease in most of its stages, and it is only during the last fifty years that we have learned how small an indiscretion may lead to an increase of fever. In the treatment of this disease, one of our main objects must be to maintain the temperature of the patient at a normal level. Rise of temperature means increased activity of the disease. Anything which increases the fever assists in the progress of the disease. In nine cases out of ten an increase in the activity of the disease is due to undue exertion—that is to say, to *fatigue*. Over-exertion is the primary cause of death in the greater number of cases of consumption. All forms of excitement, whether mental or physical, encourage and intensify tuberculosis; whilst, as we shall see, nothing is so harmful as over-exertion of mind or body. The chief essential of the treatment is that *everything which may lead to the exacerbation of the disease must be avoided, so that the damaged tissue may have time to heal*. It must be borne in mind constantly that in a sanatorium the chief consideration is the recovery of health. For tuberculous individuals this is a sufficiently difficult matter, and one to which everything else must be subordinated.

What dangers beyond those already mentioned must be avoided in the treatment of tuberculosis? A difficult point is the question whether a patient should be allowed to see visitors. If the patient's disease has become quiescent, and the process of arrest has made good progress, there is no reason why he should not see his friends, provided that discretion is used. But in the acuter stages of the disease, and in the early days of treatment, the visits of friends should be restricted as far as possible.

Must avoid anything which causes fever or exhaustion.

Vistiors.

It has been argued that the absence of friends may depress the patient, and so retard recovery, but in those sanatoria in which visitors are, to all intents and purposes, excluded, it has been found that the distress at the absence of friends, though often marked when the patient arrives at the institution, rapidly wears off. On the other hand, it has been found that visitors do not readily accustom themselves to the necessary conditions, such as the ventilation, and that they lead to unnecessary excitement. Anyone familiar with disease knows what an effect the visits of friends may have upon patients. It is true that in some cases the temperament is phlegmatic and no harm results, but in others the excitement consequent on receiving friends may lead to very grave results. It has been shown that the results obtained by treating consumptive patients at home are not to be compared with those obtained by the strict discipline of a sanatorium life. Further, visitors to a sanatorium may introduce the germs of influenza or other debilitating disease, and the opinion has been expressed not only that the visits of friends should be restricted as far as possible, but that all visitors should be received in the open air. We may conclude that in a sanatorium the more restricted the accommodation for visitors the better, as their absence seldom leads to harmful results, whilst their presence is often injurious. Gerhardt has put this in other words : ' Few people die of disappointment, but tuberculosis is a grave disease.'

Turning to the question of amusements, I may say at once that it is only within recent years that the majority of the medical profession have learned the great injury which may result, in the case of tuberculous patients, from

Amusements.

free indulgence even in such apparently trivial amuse-
ments as games of cards. I have known a patient, in
whom the disease was apparently quiescent, develop a
temperature of 102° F. entirely from a too animated
game of bridge. In many others playing the piano and
taking part in theatricals have caused a considerable rise
in temperature, and have done much to retard recovery.
Brehmer experimented upon himself with regard to the
effect produced by card-playing on the metabolism of the
body. He weighed himself every day for a week after
supper, and again two and a half hours later, hours spent
in reading or chatting, and in this way ascertained the
variation of body-weight under these conditions. He then
played a game of cards for very small stakes every evening
for another week, and found that on the evenings on which
he played cards he lost more weight than under the
previous conditions. These experiments merit repetition,
but experience supports Brehmer in his assertion that even
card-playing may in many cases lead to bad results.
Again, the temperature of excitable persons not infrequently
is increased by reading inflammatory literature, and it has
been found by experience that the reading of a certain
number of patients requires supervision. Amusements,
such as billiards and golf, which necessitate exercise, will
be considered in the next section.

Amusements
should be per-
mitted when
possible.   Whilst it is true that certain amusements do harm in
many cases, it is nevertheless the fact that other patients
are benefited by being allowed to indulge in them. If,
however, some patients are allowed too great freedom,
and others are restricted, my experience, based on an
intimate knowledge of many sanatoria, is that the discipline

suffers, and those whose liberty is curtailed become restive. *Further, anything which encourages aggregation or remaining indoors must be avoided.* The decision in all cases of what amusement may be allowed must be left to the physician. When patients understand that indulgence of any kind retards their recovery, they readily adapt themselves to the necessary discipline. The absence, however, of all amusements of any kind leads to ennui, and, in the experience of all physicians, anything which causes depression of spirits is injurious, owing to the influence of the mind upon the body. Consequently, all that tends to make the patient happy and cheerful should be permitted; all that is cheerless and depressing should be banished from his surroundings. The greater the number of amusements of a harmless kind the better for the individual.

It should be remembered that what is written above refers to patients who are being treated at a sanatorium— that is to say, to patients in whom the disease is still in a more or less active state. When a patient leaves a sanatorium, more latitude may naturally be allowed in the matter of amusements. It is often urged against sanatoria that they are dull places; but patients go to these institutions to get well, and not for purposes of amusement. Despite what has been written by many authorities on this subject, amusements which in any way excite or which can lead to a rise of temperature should be absolutely forbidden so long as the disease is active.

Amongst other debilitating circumstances I would mention exposure to draughts or to sudden changes of temperature, such as are experienced when a patient goes from a hot room to a cold passage, or gets into a cold bed.

Sudden changes of temperature and draughts.

7

With regard to sudden variations of temperature, the following passage from the writings of Sir Thomas Watson may be quoted : ' It is well known that the inhabitants of Russia are in the habit, while reeking from their vapour-baths, of rolling immediately in the snow, or plunging into cold water, without suffering from the change. Sir Charles Blagden, in describing some experiments, says : " During the whole day we passed out of the heated room (of which the temperature ranged from 240° to 260° F.), after my experiment, immediately into a cold room, and stayed there even some minutes before we began to dress, yet no one received the least injury." And Captain Scoresby, speaking of the Arctic regions, tells us that he has often gone from the breakfast-room of the vessel, where the temperature was 50° or 60° F., to the masthead, where it was only 10° F., without any additional clothing, and that he has seldom experienced much inconvenience from the uncommon transition. It is plain, therefore, that the proposition which assigns danger to sudden vicissitudes of temperature requires limitation.' Sir Thomas came to the conclusion that a sudden change of temperature is harmless when the body is hot, but that it is ' dangerous when the body is cooling after having been heated.'

Sudden changes of external temperature may do no harm to healthy people who are inured to them, but in the case of other persons, and especially those suffering from tuberculosis, they frequently give rise to an attack of bronchitis, or other disease which tends to retard recovery. In other words, sudden alterations of temperature lower the resistance and give the micro-organisms their opportunity of starting some complication, such as a cold or an attack

of pneumonia. These micro-organisms are banished from efficient sanatoria, so colds do not occur. It is perfectly true that anyone may be hardened by exposure, and may not contract disease under conditions which would kill a man brought up on hothouse principles; but the fact remains that sudden variations of temperature—not the variations due to the alterations in the weather, for these are not sudden in the sense I am using the term—lower the resistance, and therefore they cannot be of service to consumptive patients, and should be avoided, although the harm they do may not be very apparent. Draughts, in the case of people who have not yet become accustomed to an open-air existence, also tend in some obscure way to lower the resistance to the invasion of various micro-organisms. A draught may be defined for our purpose as a current of air, of a different temperature and velocity to the surrounding air, impinging on a small surface of the body. An example is a draught of cold air coming through a slightly opened door, and impinging on a man's neck.

Any heating arrangements must be of such a character, and the temperature of the rooms of such a height, that no sudden variations can occur. Every precaution to prevent chilling of the patient should be taken, such, for example, as the use of sheets of a mixture of wool and cotton, as these are worse conductors, and less cold than linen. Draughts—that is, unpleasant currents of air—may usually be avoided by making the inlet and outlet for the ventilation sufficiently large. Precautions must also be taken to prevent any diminution in the humidity of the air owing to the heating apparatus.

Heating arrangements.

7—2

Exposure
to wind.

One more debilitating influence may be mentioned. Blumenfeld and others have shown that exposure to winds, more especially to cold winds, is injurious, and the conclusions of these observers are borne out by the experience of all sanatorium authorities. The injurious effect of wind is due to two causes: (1) The dyspnœa it excites, and (2) the loss of heat which occurs in consequence of the great amount of air which passes over the body. All buildings for the treatment of tuberculosis should be well sheltered from cold winds, but in addition, both in the grounds and elsewhere in the neighbourhood, precautions should be taken against any excess of wind by the provision of artificial shelters.

Exposure to
the sun.

The sun is an amenity and a cordial, and Rienzi has shown that it lengthens the lives of animals affected with tuberculosis. Too great an exposure to it is debilitating, and according to some authorities leads, in certain cases, to hæmoptysis. Consequently, measures must be taken for protection against the sun in hot weather.

3. Methodical Hill-Climbing as an Exercise when the Condition of the Patient does not Necessitate Repose.

The heart in
tuberculosis.

Brehmer, as has been said, observed that the inhabitants of Görbersdorf had powerful hearts, and were free from tuberculosis, whilst tuberculous patients had small hearts and large lungs, and he came to the conclusion that anything which helped to strengthen the heart, not only tended to ward off the disease, but was a most hopeful method of treatment. Baudement and Nathusius had shown that in many animals, such as oxen, the lungs and

heart are in proportion to the body-weight. In other words, the greater the body-weight, the larger the heart and the smaller the lungs. Brehmer argued that many tuberculous patients, who nearly always have poor appetites at the growing period of life, have small hearts and large lungs in consequence of their low body-weight. Such observers as Rokitansky, and more recently Hutchinson, support Brehmer in this view. On the other hand, some authors, amongst whom may be mentioned Meissen, deny that a small heart is at all common in tuberculosis. Whether this be so or not, it is at least certain that the heart is distinctly enfeebled in this disease, and Leyden, Strüm-pell, and other observers, have shown that partial atrophy of the cardiac muscle is not infrequently met with, so that there can be little doubt that anything which tends to increase the cardiac power is of value in the treatment of the disease. Von Ruck further holds that it is necessary to increase the power of the heart in tuberculosis of the lungs, in order that it may be able to deal with the pulmonary obstruction caused by the disease. Brehmer, in accordance with his own views, insisted on his patients taking gradual and slow uphill exercise whenever this could be done without producing fever or other unfavour-able results, and this method of treatment is followed in many sanatoria at the present day. He held, however, that in many cases the exercise should be extremely moderate in amount, and should be often replaced by entire repose—that is, repose both of mind and body—a condi-tion which can be obtained only by more or less complete isolation.

Dettweiler, however, introduced a modification of

Brehmer's plan of treatment, and substituted rest in Liegehalle or verandas in place of uphill exercise. These two systems necessitate a different form of treatment, and I must therefore discuss them a little more in detail. All sanatorium authorities, however, agree that, under certain conditions, rest in isolation is necessary for consumptive patients. Such conditions constantly arise even in institutions restricted to patients in the very early stages of the disease.

Value of rest. Whenever there is active inflammation in the lungs, bodily rest is imperative. This is common-sense, and merely an adaptation of the teaching contained in Hilton's classical essay on rest and pain. Hilton showed conclusively that in the acute stages of inflammation, whether it be of an extremity or an organ, movement does nothing but harm. No one thinks of permitting exercise in the case of typhoid fever or pneumonia, and the same should be equally true of the inflammatory stage of tuberculosis. This view is accepted in the case of tuberculosis of the hip-joint, and should be adopted when the lungs are the seat of the disease. In pulmonary tuberculosis we know that as soon as inflammation commences Nature takes prompt steps to diminish movement on the affected side. Bonnet Léon and H. Walsham have shown, by means of the X rays, that under ordinary conditions the diaphragm does not become flatter on inspiration as was supposed, but that it plunges up and down like a piston, without any alteration in its curve. Whenever one of the lungs is affected, however, with tuberculosis, even if the disease is limited to the apex, the movement of the diaphragm is sensibly diminished on the affected side. Again, every

pathologist knows that when the lungs become tuber-
culous, adhesions are formed in the majority of cases
between the lungs and the pleura. Nature, by means of
these anchors, and by diminishing the movement of the
muscles of respiration on the affected side, makes every
endeavour to keep the diseased part at rest. Nature is
usually a safe guide, and experience has shown that in
all stages of tuberculosis one of our chief endeavours must
be to prevent anything which tends to throw a strain
upon the lungs, such as dyspnœa or cough. Another
point in favour of rest in certain instances is that one of
our aims in the treatment of tuberculosis is to main-
tain the temperature of our patients at a normal level.
Exercise is one of the chief causes of a rise of temperature
in this disease, and has, in fact, been used for diagnostic
purposes. In the acuter stages of the disease pulmonary
rest can only be assured by absolute bodily rest. In this
way we allow the diseased part of the lung time to heal
by a natural process. The record of such treatment
shows what excellent results may be obtained. The in-
flammatory process gradually diminishes, and the disease
becomes quiescent.

Just as in the case of a fractured leg there comes a time
when massage and passive movements are imperative, so
when tuberculous disease has become sufficiently quiescent,
exercise in some form or another must be taken. It is
admitted by all physiologists and pathologists that for the
body to be in perfect health it must be maintained in
activity. Exercise promotes not only the nutrition and
energy of the voluntary muscles of the heart, bloodvessels
and respiratory organs; it powerfully assists the aeration

*Disadvan-
tages of too
prolonged
rest.*

of the blood, and in this way keeps all the organs of the
body in a healthy condition.   An equally important func-
tion of exercise is that it assists in the elimination of
various substances through the lungs, the kidneys, the
bowels, and the skin.   Another advantage, as Sir Hermann
Weber has said, is that it strengthens the nervous system
and counteracts the mental depression, which has a lower-
ing effect on the vitality of the body.   On the other hand,
it has been urged, and justly urged, that patients who
undergo treatment by rest in the recumbent posture be-
come lazy in the extreme, and never regain energy enough
to resume their former mode of life.   This is an important
point in the case of patients who are not possessed of
wealth, for we must endeavour by every means in our
power to arrest the disease under conditions which are as
nearly as possible those obtaining in the life to which our
patients have to return.   Meissen, who follows the Liege-
halle method, asserts that he has never seen a patient
attain the maximum development of health by this
method alone, but has, he says, seen better results even
in those patients who have taken more exercise than they
ought to have done.   Brehmer was convinced that the
reason why Dettweiler at one time obtained unfavourable
results, and thus was led to alter his treatment, was that
the patients at Falkenstein were allowed to walk too fast,
and that the return walk was often uphill.   Dettweiler
himself has freely confessed that the method of treatment
which he introduced may be carried to an extreme; for
when the patient is kept at rest for long periods, even in
the quiescent stage of the disease, there is a rapid gain of
weight, which consists largely of fat rather than muscle

or bone, and the time comes when the capacity of the lungs and heart is overstepped, and the patient becomes more breathless than before. As Sir R. Douglas Powell has observed, such a transgression of the physiological balance of the cardio-respiratory functions and body-weight is to the positive disadvantage of the patient, and results in an attack of dyspepsia, diarrhœa, or hæmop-tysis, by which Nature attempts to rectify the effects of our want of foresight. · Patients with extensive disease are, indeed, more comfortable if their weight does not exceed a certain limit. Knopf, too, who was at one time Dettweiler's assistant, asserts that the recumbent position necessitated by Liegehalle facilitates hypostatic congestion of the lungs, and that the patients' backs become more sensitive to changes of temperature.

The relative statistics of 'cures' which have followed on the adoption of these two forms of treatment cannot be accepted as a guide for many sufficiently obvious reasons, but remarkably good results are obtained at such places as the Nordrach Colonie, where exercise is pre-scribed at the earliest possible moment. I can confidently assert from my own observations of many cases treated by both these methods, that the Liegehalle system does not lead to such good or to such permanent results as the system adopted by Hermann Brehmer and Otto Walther. It must be remembered that cases in all stages of the disease are admitted at Nordrach, and that good results are obtained not only in the early stages of the disease, but also in the more advanced ones. If, then, exercise benefits patients with extensive disease, it cannot fail to be of service to those whose disease is less

Comparison of Walther's and Dett-weiler's systems.

advanced. Finally, at several sanatoria, as, for example, Dr. Driver's at Reiboldsgrün, better results have been obtained since patients were permitted to rest in shelters and in the woods rather than in Liegehalle.

We see, then, that there is much to be said for exercise in certain phases of the disease. We may also conclude that the form of exercise adopted must be of such a kind that, whilst it leads to active and healthy metabolism, it does not throw any strain upon the lungs, or excite dyspnœa. It is clear, however, that rest must frequently be enforced by the physician, as, for example, when there is active inflammation. Further, there is an excellent rule at many sanatoria that one hour's rest should be taken before both the mid-day and evening meals, so that the patient may approach a meal not immediately after a walk, but when he is rested. The effect of muscular fatigue, both on the appetite and digestion, is well known, and it is important that a patient should sit down to his meals with his powers of digestion and assimilation unimpaired.

How can this rest be most efficiently secured ? Is it most easily obtained in Liegehalle or in the seclusion of the patient's own room ? In the first place, in many cases, if such rest is necessary, the effort involved in going from the bedroom to the veranda, or of leaving the veranda for meals or for certain physiological processes, entails too much exertion. Again, in verandas patients tend to collect in chattering groups, and, forgetful of advice, to gesticulate or become excited, so that dypsnœa or cough is induced, whilst many who need absolute quiet may make efforts to entertain their neighbours. If intervening glass

Conclusions.

Where should the patient rest ?

Objections to verandas.

screens are used to prevent this, one of the main values of a veranda is lost. In addition, there are many structural objections to Liegehalle in the climate of England. They block out too much light, unless the building is so arranged that they are placed before a basement, or the interval between the stories is much increased, both of which procedures lead to a large outlay without any compensating advantage. Verandas are not easily kept clean in the strict sense of the term, and in the nature of things cannot contain as pure an atmosphere as is found in the open air, or even at the window of a room that contains only one person. Moreover, they interfere with the privacy of patients confined to bed, and may disturb their rest, whilst in summer they tend, if covered by glass, to become insufferably hot.

Brehmer and others, recognising the enormous part that the mind plays in the question of bodily health, insisted that when rest was required it should be absolute, that both mind and body should be free from all forms of excitement. They held that this could only be done, as Leriche has proved, by complete seclusion, and the results obtained by them have more than justified the assertion. They have, however, found that in a small number of cases the patients tend to become depressed, and fail to make progress, when isolated in this manner, and they came to the conclusion that patients of this class, when kept at rest, improve more rapidly when they are allowed to associate with not more than two or three of their fellow-creatures for an hour or more daily, preferably in open-air galleries, to which their beds may be wheeled. We see, then, that the majority of patients, when their

Absolute rest possible only in seclusion.

condition necessitates rest, should be confined to their own rooms.   Most medical men object to a patient remaining for long in a single room, but it has been proved that the rooms of a sanatorium may be freely ventilated, and this argument therefore loses its force.

When should exercise be prescribed?   A more difficult question which we now have to answer is, Under what conditions should exercise be prescribed ? Nowhere in the extensive literature on the subject are these conditions laid down.   The answers to this question given me by some fifty medical men in charge of sanatoria show that no absolute rules can be given, the reason being that the conditions under which exercise should be prescribed depend largely on the personal equation of the patient, and can only be dealt with and properly appreciated by the physician in attendance after a full consideration of the individual merits of each case.   This, indeed, is one of the most valuable lessons the sanatorium method has taught us—namely, that no definite rule can be laid down.   It may, however, be said that exercise must be prescribed whenever it does not tend to exacerbate the disease, and that this can only be determined in each individual case by experiment, guided by the observation and experience of the physician in attendance.   A patient should be kept in bed until he can take ordinary food, and certain conditions, such as fever, rapid action of the heart, a ready tendency to exhaustion, extensive or rapidly advancing disease, or an irritable nervous system, contraindicate exercise and necessitate repose.   A temperature of 98·6° F. in the morning indicates usually the desirability of rest, but I have known patients with a temperature of 100° F. or more fail to make any progress until

Exercise

they were permitted to take a certain amount of exercise.

When exercise is prescribed, what is the best form? What form of exercise is advisable? More people suffering from tuberculosis have been killed by over-exertion than by anything else. Exercise must, therefore, never be pushed so far as to cause fatigue or to lead to a return of disease or cough, or to any other bad symptoms. For some patients slight massage or the mere exertion of dressing may be enough; others may only be able to walk a few yards on level ground. Others, again, whose means allow it, may benefit by driving slowly in ordinary carriages, or in suitable electric motor-cars; but in the majority of quiescent cases experience shows us that the best form of regular exercise is uphill climbing. Such exercise must be gradual and deliberate, the gradient must be easy, and the pace should not, as a rule, exceed one and a half to two miles an hour. The patient must not hurry, even if caught in a shower, for any increase in the number of respirations does harm by increasing the work of the lungs. Every provision should be made for the patient to rest if he is at all tired, whilst the sanatorium should be so situated that patients are not tempted to start downhill and return uphill. Both the public and the medical profession are too much afraid of a little rain or mud, and one objection urged against this form of exercise is that it may lead to exposure to heavy rain or inclement weather. On the other hand, the experience of the sanatoria where this form of treatment is practised shows that it leads to very good results.

The only precaution taken in these institutions is Protection against wind and rain. shelter from wind. It is argued that no rheumatism and

no chill result even from a thorough wetting, and some
authorities go so far as to prefer their patients not to
change their clothes even when wet through. The general
consensus of opinion, however, is that, even if wet clothes
do not lower the vitality, they can at least do no good. It
is uncomfortable to remain long in wet clothes, so that
adequate provision should be made for drying the patient's
garments. Protection may be obtained by means of trees
or suitable shelters in the grounds, and the paths should
be so constructed that they absorb moisture and rapidly

Exercise
under cover.

dry after rain. Exercise under cover, as Brehmer has
shown, cannot, save under exceptional circumstances, be
of service, as it is impossible to keep the atmosphere
sufficiently pure where a number of people are assembled.
No provision, then, need be made for exercise under
cover, although there can be no objection to suitable
covered passages, which are freely open at the sides,
being erected between certain of the different buildings,
more especially as this conduces to the comfort of the
patients, by sparing them unnecessary exposure to rain.

Until lately it was held that other forms of exercise
such as billiards, tennis, and golf, were contra-indicated
unless the disease had been completely arrested for twelve
months or more. It is probably true that such forms of
exercise are likely to cause harm in the majority of cases,
as they involve too sudden movements and too much
excitement. In view of the results obtained by Dr. Pater-
son at the Frimley Sanatorium, however, we must take a
wider view of what forms of exercise are permissible when
the patient is making steady progress on graduated walk-
ing exercise. Dr. Paterson has carefully tried the effect

of labour of various kinds, and has obtained astonishing results. It must, however, be remembered that these results are in great part due to the fact that patients who go to Frimley are carefully selected, and that before they go there they have had at least three months' treatment in the Brompton Hospital. In prescribing labour on the lines worked out by Dr. Paterson these facts must be borne in mind, for it is still true that the avoidance of any overexertion is of great importance. This is shown in Manders Smyth's account of his own case, in which he relates how, after months of improvement, he suffered a relapse, owing to a comparatively trivial amount of tobogganing. This relapse cost him five months of extra treatment. Similar examples of harm resulting from the imprudence of patients are far from uncommon.

Overexertion leads to relapse.

Dr. Paterson prescribes exercise and labour for two periods daily, each of two hours' duration. A patient is first placed on grade 1, and then, as improvement shows itself, successively on grades 2, 3, etc. If the work of one grade is found to lead to rise of temperature, increase of weight, or other bad symptom, the patient is at once replaced on a lower grade.

Dr. Paterson's grades of labour.

The grades are as follows: (1) Slow walking exercise, beginning at two miles a day and gradually increasing up to ten miles a day; (2) picking up fir-cones and firewood in the grounds, and carrying a half-basket (weight, 11 pounds) to the stack; (3) carrying a full basket of firewood and cones (weight, 16 pounds); (4) carrying a half-basket of gravel or stones from the gravel-pit to the place where paths are being made or repaired (weight, 21 pounds); (5) carrying a basket of gravel or stones, the

weight of which is gradually increased up to 38 pounds;
(6) rolling the grass or gravel (sixteen men pull a roller
weighing 15 hundredweight); (7) digging ground already
broken; (8) mowing grass with a lawn-mower: (9) digging
unbroken ground; (10) the same as under (9), but for six
hours daily instead of four hours—*i.e.*, the hours usually
spent at rest are spent in labour.

No patient is classified on discharge as 'arrested,'
unless for three weeks continuously he can pass one or
other of the following tests:

Test A : For a Patient who earns his Living by Manual
Labour.—To be able, on an ordinary diet and without rest
hours, to use a pick and shovel of the full size and weight
for six hours daily and to maintain his health. The
shovels and spades are of three sizes, weighing 2, 4, and
6 pounds respectively. The picks vary from 3 to 7 pounds
in weight.

Test B : For a Patient who does not earn his Living by
Manual Labour—*e.g.*, Clerks, Shopmen, or Salesmen.—To
be able, on an ordinary diet, to perform the labour of grade
No. 6 or No. 7 for six hours daily for three weeks and to
maintain his health. These patients are, as a rule,
gradually brought up to No. 9, and when it is found that
they can do this work they are put back to No. 6 or No. 7.
The theory is, that a man doing the work described under
No. 9 or No. 10, who, on discharge, will engage in work
involving but little bodily exercise, would suffer in health
from such an abrupt transition. Further experience is,
however, necessary upon this point. In some cases it is
found that patients are unfit for No. 9, but that they can
be raised to a standard of labour which is equal to their

ordinary work. These patients are tested before discharge on the grade to which they have attained; but they are not, as a rule, classified as 'arrested.'

The system has been gradually evolved, and has not yet been in operation for a sufficient time to justify the expression of a final opinion as to its value; but there appears to be every reason for anticipating that it will prove successful. A visit to the sanatorium will convince anyone of the healthy, not to say robust, appearance of the patients on graduated labour. The desire of every patient on walking exercise is to be allowed to work: the man who is engaged collecting wood envies the man who is carrying gravel; a patient with a large pickaxe is regarded as a fortunate being by his neighbour with a small one. There is, in fact, a general desire to obtain promotion to a higher grade of labour. So marked is this feeling, that experience has shown that constant supervision and surprise visits are necessary, not, as might have been anticipated, to ascertain that the patients are doing their work, but to see that they are not exceeding the amount of work prescribed.

A form of exercise which is not infrequently practised at sanatoria is pulmonary gymnastics by means of the pneumatic cabinet and other contrivances, the idea being that the healthy portion of a lung undergoes hypertrophy, and that in this way loss of tissue is compensated. Brehmer, Liebermeister, and Volland were strenuous opponents of this form of exercise; Baümle asserts that it has led to aspiration pneumonia; Michaelis and others have recorded instances of harm resulting; whilst at the Volkheilstätte, Loslau, it has been tried and given up. Many authorities,

Pulmonary gymnastics.

8

on the other hand, have shown good results from this form
of treatment in cases where the disease was practically
arrested. Such exercise may readily throw a strain on
the lung, and may thus set the smouldering disease aflame ;
the limits of compensation are readily overstepped, with
the result that a harmful emphysema may be developed.
It is, moreover, a question whether such expansion of
the lungs is necessary, for, as Dr. C. Theodore Williams
has pointed out, the human body has a much larger lung
surface than is required for ordinary respiration ; under
ordinary circumstances an individual does not expand his
lungs more than half, whilst a patient may exist in bed
with an expansion of one-twelfth. Loss of lung tissue
does not necessarily mean that the respiratory capacity
is below the ordinary needs of the patient. There is
ample lung surface in most consumptive patients to deal
with the amount of blood in the body, and there is no
necessity for such patients to inflate the chest unduly,
and thus run the risk of strain, the development of
emphysema, and, with the latter, the tendency towards
hæmorrhage.

Conclusions.   We see, then, that, as regards rest and exercise, we
may group patients suffering from tuberculosis under the
following headings :

  (1) Those who can take exercise more or less freely.
  (2) Those who can take slight exercise on level
      ground.
  (3) Those who should be isolated in their own rooms.
  (4) Those who, though unable to take exercise, should
      be allowed to associate with a few other patients
      in a small open-air gallery or other form of shelter.

4. An Abundant and Varied Dietary in which
Milk, Butter, Fat, and Vegetables occupy an
Important Place.

A marked feature of tuberculosis is the loss of appetite *Necessity of an abundant dietary.*
which results from the progress of the disease, and it is
consequently agreed on all sides that, in the treatment
of this disease, one of the most important points is to
insure that sufficient nourishment is taken to make up the
past loss, and to maintain the body-weight appreciably
above its normal limit. In this way the process of repair
is stimulated, the resistance of the individual increased,
and the susceptibility or tendency towards relapse lessened.
So true is this that Sir R. Douglas Powell considers the
sanatorium cook to be only second in importance to the
medical man; whilst Dettweiler, when asked whether he
used drugs much in the treatment of consumption, pointed
to his kitchen, and exclaimed, 'That is my pharmacy;
there is my chemist's shop.' The object of the dietary is
to increase the weight gradually to the normal, or some-
what above the normal value, for, as Weir Mitchell has
shown, a rise in weight up to a certain point goes hand-in-
hand with a gain in all other essentials of health. By
weighing patients once a week a good guide, up to a *Weighing.*
certain point, is obtained of their progress, and at the
same time the patient finds practical encouragement from
the progressive increase in his weight. It is important
that the weighing should always take place at the same
hour and under the same conditions on a reliable
machine week after week. The quantity of food eaten
must be considerable. It must at least equal in amount

that which is eaten by an ordinary healthy individual; whilst patients must be persuaded to eat everything that they are given, under pain of being sent away from the sanatorium, as this disciplinary measure is productive of most excellent results.

The character of the food.
With regard to the character of the food, it is found that, although solid food is infinitely the best form, and in many cases affords the readiest means of reducing fever, yet, in a sanatorium, owing to the different stages of the disease which are treated, the diet must range from the fever diet of a hospital to a full diet of plain and wholesome food. Tuberculous patients derive the greatest amount of benefit when placed on an ordinary diet to which an excess of fatty material is added. Otto Walther lays great stress on the amount of butter which his cook adds to the gravy in as pleasant and unobtrusive a guise as possible, and on the amount of starch in the potatoes. Walther, in fact, has the potatoes and other articles of food carefully analyzed before use, so that his patients may be given the best that are in the market.

Experimental results show moderately large diets give best results.
In consumption with high fever the digestion both of nitrogen and fats is good, as has been shown by Goodbody, Bardswell, and Chapman, who found that quantities of food which produce illness in ordinary individuals have a favourable effect on consumptive persons. They discovered, too, that even when patients were far below their normal weight better results were obtained by moderately large than by very large diets, and it was proved that a maximum amount of absorption was obtained by means of a medium diet. These authors also have shown that

Absorption of fats.
the absorption of fats by consumptive patients is excellent,

96·41 per cent. being absorbed, even when as much as 231·32 grammes were given.

Brehmer insisted on the importance of an ample supply of vegetables, as he said that without them patients with advanced disease chew their meat, roll it from side to side, and are unable to swallow it. Vegetables, on the other hand, need little chewing, but are easily swallowed, and so help the deglutition of other food. Further, vegetables contain much of the carbohydrate material recommended by Strümpell and Eichhorst. *Importance of vegetables.*

Milk is one of the best foods for increasing the weight, and in most sanatoria patients take from 3 to 5 pints a day until they have recovered their normal body-weight. *Milk.*

As the disease becomes quiescent, and the patient approaches his normal weight, the amount of food must be diminished. It is one thing to fatten a patient, and another thing to give him strength and muscle, and it must be admitted that, unless exercise is taken at the same time, the gain of weight is not infrequently more in fat than in anything else—fat which often disappears when the patient leaves the sanatorium, and which, when it is present, tends merely to impede the patient's movements and make him short-winded. *Amount of food must be diminished when normal weight is regained.*

5. Various Hydro-therapeutic Measures.

One of the most noticeable features in tuberculosis, when at all advanced, is the unhealthy character of the skin. Perspiration is readily produced, whilst parasitic affections, such as *Pityriasis versicolor*, are frequently met with. It has been found that the best way of improving the action of the skin, and at the same time lessening *The skin in consumption.*

the liability to what is termed a chill, is by proper hydro-
therapeutic measures, more especially by means of some
form of needle or shower bath, combined with friction,
provided always that individuals are not allowed by
vigorous drying, or in other ways, to tire or overexert
themselves. In this connection Sir Thomas Watson
observed: ' The most direct and certain mode of fortifying
Necessity for the body against injury from accidental exposure to cold
shower-
baths. is afforded by the use of the cold bath, and especially of
the shower-bath. When this is regularly taken in the
morning, the surface of the body becomes inured to a
degree of cold greater than it is likely to encounter during
the remainder of the day. It is fortunate that we have an
easy criterion of the propriety of continuing this expedient.
When the sense of cold does not remain long, and is
followed by a glow of warmth, the cold shower-bath is
sure to do good. If, however, after the bath the person
suffers headache, and continues to be chilly, languid, and
uncomfortable, it should at once be given up as useless,
and even hazardous.'

6. The Importance of Constant Medical Super-
vision.

Need of
supervision.   We have seen in the previous pages that sanatorium
treatment is based upon a careful regulation of a patient's
life in all its hygienic and medical details, and it is
to attention to detail and to the avoidance of what is
harmful that this form of treatment for tuberculosis owes
its extraordinary results, and its superiority over all other
methods. Solly has shown by statistics that in the beauti-
ful climate of Colorado there is an enormous difference in

the mortality among consumptive patients under medical control compared with that of those who merely consult a physician when they think it necessary. In order to direct a sanatorium efficiently, or, indeed, to look after a single private patient, the physician must have absolute power. He must be an autocrat, and his word must be law. He must be prepared to give his entire energy to the work, for, as Dettweiler has expressed it, his patients must be his religion, his politics, his despair, and his delight. He must be a man of many parts; he must gain the confidence of, and, if possible, make allies of, his patients; prevent imprudence in some cases, encourage perseverance in others, strictly enforce all essential rules, and yet allow sufficient liberty in less important details to prevent the irksomeness of restraint. Tuberculous individuals have a happy-go-lucky way of following their own devices, and are in constant need of supervision. As I have said already, every detail likely to exercise an influence upon either the condition of the general health or upon the course of the disease must engage the physician's most earnest attention. Even in health people differ greatly in their power of reaction, so that what is bracing to one is depressing to another. 'What is one man's meat is another man's poison' is an old saying, but never more true than in the case of tuberculosis. In this disease we have an ever-changing picture. In its treatment there is no fixed rule, and such general rules as exist have to be altered more frequently than they are followed. Each tuberculous individual must be dealt with on his merits; his personal equation and his power of reaction must receive the most painstaking consideration. It is only by

Necessary character of the physician.

Importance of details.

Each case must be treated on its merits.

constant medical supervision that we can take advantage of the variations in the patient's condition or prevent harm. Each patient in a sanatorium must be visited by the medical man before breakfast and again twice a day ; for example, after the morning and afternoon walk, so that he may see at once whether exhaustion or other bad effect has supervened, and may map out the daily details for the individual patient according to his condition. Patients kept at rest may occasionally require even more frequent supervision. Again, either the physician in a sanatorium, or some other responsible person, must take his meals with the patients, as in this way the amount of food can be apportioned to the varying requirements. He can sit near and encourage those who have any difficulty in eating the rather large quantities of food which are necessarily given them, and he can do much to prevent, by his presence, the many petty deceptions, such as the pocketing of food, of which experience has taught us sanatorium patients may be guilty.

We are now in a position to tabulate requirements to be met by a sanatorium for the efficient treatment of tuberculosis as follows :

A. With regard to treatment—

1. Advantage must be taken of everything by which we can increase the patient's bodily strength and his resistance to disease, so as to render the tubercle bacilli innocuous.

> (a) The patient must lead an absolutely regular life under constant medical supervision.
>
> (b) He must spend the greater part of his time in the

open air, and must constantly breathe pure air.

(c) Good, nourishing food, with a large proportion of the fat-making substances, must be taken in sufficient quantity to establish and maintain the normal body-weight of the individual patient.

(d) Slow, uphill exercise must be taken as soon as this can be done without causing fatigue, or bringing about an exacerbation of the disease, the amount of exercise being varied by the physician according to the condition and the reaction of the patient.

(e) Each patient should have a daily shower-bath unless confined to bed, in which case he should be sponged.

2. Everything which may lead to an exacerbation of the disease must be avoided, so that the damaged tissue has time to heal.

(a) Until the disease is arrested, all forms of strain, whether of the lungs or any other portion of the body—for example, the strain on the lungs and muscles caused by exposure to excessive wind, or by playing such games as billiards, golf, or tennis, which involve much movement of the arms.

(b) Any form of excitement in the active stage of the disease, such as the visits of friends or games of cards.

(c) Anything which encourages aggregation or remaining within doors.

(*d*) All sources of reinfection.

(*e*) Sudden unnatural changes of temperature.

(*f*) All sources of irritation, such as dust.

It is unnecessary to go into any detail here about the building of an efficient sanatorium, beyond stating that in an institution of the kind the following requirements* should be met :

Tabulation of requirements to be met in the building of sanatorium.

B. The accommodation should be comfortable, a separate room being provided for each patient ; the buildings should be on an elevated and sloping site, with a sunny exposure, and well sheltered from cold winds, and should be surrounded with wooded and open country. There should be a farm at a convenient distance. The soil should be dry and permeable, and the water-supply abundant and above reproach, whilst the sanitary arrangements must be of the most modern type. In addition—

1. The ventilation should be such that the air contained within the rooms and passages is free from all sources of contamination, and rivals the outside air in point of purity, whilst at the same time draughts are not encouraged.

2. The buildings should be so situated, and of such a kind, that dust is as far as possible avoided.

3. The buildings and the fittings should be of such a kind that such dust as inevitably collects can be readily removed.

4. Arrangements should be made for the ready and effectual destruction or disinfection of all infected material.

* This tabulation is taken from the author's prize essay for the erection of the King Edward VII. Sanatorium.

5. The buildings should be of such a nature that constant medical supervision can be readily exercised.

6. The quarters of the medical staff should, as far as possible, overlook the grounds.

7. The bedrooms of the sexes should, as far as possible, be in different blocks, but there is no necessity for separating the men and women in the dining-room or grounds.

8. Four classes of patients must be provided for, both in the sanatorium and in the grounds—

    (*a*) Those who can take exercise more or less freely.
    (*b*) Those who can take slight exercise on level ground.
    (*c*) Those who must be isolated in their own rooms.
    (*d*) Those who, though unable to take exercise, may be allowed to associate with a few other patients.

9. The accommodation for visitors must be limited.

10. No provision so far as buildings are concerned need be made for amusements beyond a recreation-room, which may also serve the purposes of a library.

11. No provision should be made, in the case of those who have active disease, for games such as billiards, tennis, and others, which involve much movement of the arms or lead to excitement.

12. A few open-air galleries are of service, but nothing approaching the Liegehalle system should be erected.

13. The dining-room and kitchen should be completely cut off from the patients' rooms.

14. The kitchen arrangements should be of the most modern type and thoroughly sanitary.

15. The dairy and the farm should be of a model character.

16. There should be ample accommodation for hydrotherapeutic measures.

17. Adequate arrangements should be made for drying clothes.

18. The heating arrangements should be such that the temperature is never raised more than a few degrees above the outside temperature, so that no sudden variations may be experienced when the patient leaves his room, and that the humidity of the air is not sensibly diminished.

19. Adequate shelter should be provided in the grounds and elsewhere against wind, excessive sun, or heavy rain.

20. No special arrangements need be made for exercise under cover in bad weather, though it is as well to provide covered ways between certain of the different buildings.

21. All facilities should be provided for the treatment and clinical observation of the patients, by the aid of laboratories and special departments.

CHAPTER VI

DETAILS OF THE OPEN-AIR METHOD OF TREATMENT
AS CARRIED OUT AT HOME

WITH few exceptions, patients should be sent to a sana- Patients should go to a sanatorium first. torium as soon as we are in a position to say positively that they are suffering from consumption. It is true that in some instances just as good results can be obtained by a patient being sent away from his friends in the charge of a physician or nurse specially trained in this form of treatment. Treatment on these lines, however, is expensive, and is seldom called for. There is nothing peculiar about sanatorium treatment. A sanatorium is an institution which exists for the purpose of placing its inmates under ideally healthy conditions, and a sanatorium of this kind will do just as much for people suffering from anæmia, syphilis, or other diseases, as it will do for tuberculous individuals. Apart from this, the main value of a sanatorium is the fact that it is a school, and personally I send patients to such institutions chiefly that they may learn how to live correctly in a medical sense.

Consumptive patients should go, then, to a sanatorium, and stay there, if possible, until the disease is arrested. If they cannot devote as much time as this procedure involves, I always prefer them to go to a sanatorium for

a varying time, in some cases for as short a period as a month, before entering upon their treatment at home. It is necessary for consumptives to learn how to live and how to avoid the various conditions which militate against their return to health. This they can best do in a special school for the subject, such as an open-air sanatorium. Even if they can only go there for a brief period of time, and are forced from one cause or another to leave before the disease is arrested, they are enabled by this means to obtain an insight into the principles of the treatment, and to grasp the immense importance of many details, which they would otherwise regard as trivial. When patients leave the sanatorium after two or three months' residence their disease may be quiescent; it is, however, seldom arrested, and is rarely cured, consequently they must continue the treatment under home conditions for a prolonged period of time—it may be for years—in fact, until their medical adviser feels justified in saying that the disease is permanently arrested.

This procedure is not always possible.

It is not always possible for a patient afflicted with consumption to go to a sanatorium. The question of expense or difficulty in leaving home may make a residence in a sanatorium impracticable, or patients may be too ill, whilst many have an insuperable objection to these institutions. Again, a patient not infrequently has to wait a considerable time before he can be received into the existing *efficient* sanatoria. Consequently, all medical men must be prepared to treat such patients amidst their own surroundings. It is my purpose, therefore, in this chapter to indicate the necessary precautions and treatment in greater detail than when I discussed the essential

principles ; but in doing so a certain amount of repetition is unavoidable.

In treating a patient at home many difficulties in the matter of suitable accommodation present themselves, and a considerable amount of ingenuity is often required to surmount them.   In the following remarks concerning the character of the rooms to be occupied by a tuberculous individual, my desire is not to be dogmatic, but rather to state the best conditions, which should be approached as closely as possible according to the varying circumstances of individual cases.   It is, unfortunately, true that in many instances patients are unable for many reasons, such as the question of expense and the character of the locality in which they reside, to conform with the directions given in the next few pages in the matter of buildings and the like.   Full details, however, are given in order that the general outline of the necessary conditions may be followed as closely as structural or financial considerations allow.   *In many instances the best conditions are obtained by erecting a tent or a simple wooden shelter in the garden or grounds of the house, the floor being raised a foot or two above the ground.*   In this shelter the patient, at any rate during the summer months, may sleep ; he should have his meals, and rest as much as possible, in the open air.

If a patient is treated at home, it is imperative that he should be frequently seen by his medical attendant, for it is only by constant supervision that we are enabled to grasp the peculiarities of any individual case.   No disease varies so much in its manifestations in different people, and consequently it is not only impossible, but absolutely wrong, to give any particular patient a general outline of

treatment, to enable him to look after himself, before the disease has been practically arrested. Too strong emphasis cannot be laid on the fact that in the modern treatment of consumption it is imperative that we should treat the individual as much as the disease. There is no question of hard-and-fast rules ; the personal equation and the reaction of the patient are too variable for us even to attempt to formulate general rules. Therefore, if a consumptive patient is treated at home, he must have expert advice, to enable him to avoid all pitfalls, and to take the greatest possible advantage of any favourable conditions. His family will also have to make certain sacrifices, and enter into loyal co-operation with him.

General considerations.   We have already seen that within limits any climate will give favourable results in the treatment of consumption, provided that the air is pure and bracing. Good results within limits have been obtained by the hygienic method of treatment in large towns, and even in open-air galleries of general hospitals, but every patient should endeavour to live in the country for the first six months of his treatment. The question whether different climates are required by special cases is discussed in Chapter IX. (p. 227), but the majority of observers are of the opinion that all persons suffering from tuberculosis should, as far as possible, undergo treatment under the same climatic conditions as they are likely to experience in their subsequent life.

Position of house.   The majority of patients are well advised if they can arrange to live in a suitable house at an elevation of 300 to 700 feet, with a sunny exposure and well sheltered from the prevailing winds. The direction of the prevailing winds differs widely in different localities, but, as a rule,

it is desirable in the treatment of tuberculosis in England to have protection against the northerly and easterly winds, although in some districts the wind to be specially avoided at certain seasons of the year is from the south-west. The house should be surrounded by open country, well wooded, more especially with pine-trees, as these combine shade with shelter from rain, and, unlike deciduous trees, are useful both in winter and summer. The soil should be dry and permeable, so as to facilitate surface drainage, and the water-supply should be abundant and above reproach. The house should be well removed from all sources of dust and smoke, and consequently should be away from public roads. It should be so placed that the ground in front of the main aspect is well cleared, in order that a free circulation of air may be permitted, and the patient be able to enjoy the view. In the immediate vicinity there should be a sufficient number of trees to afford adequate shelter in the event of the patient being restricted to a small amount of exercise. Paths should lead away from the house in such a manner that the patient need not descend to a lower level when he sets out for a walk, and then—it may be when he is more or less tired—return uphill.

The published and unpublished results of sanatorium or hygienic treatment show clearly that the mere aspect of the rooms occupied by tuberculous individuals has no marked effect on the results of treatment. There can, however, be little doubt that for patients who are confined to their own rooms, as many must be from time to time, it is advisable, from the point of view of their comfort, that the rooms occupied by them should be so placed that they have the advantage of the rays of the sun. These

Aspect of the bedroom.

are grateful to the patient, and Nature's best disinfectant.
The bedroom should also be in such a position that it is as
much sheltered from strong winds as the nature of the
site allows, in order that the windows may be kept open
as freely as possible.   It is, however, a mistake for the
patient's room to be in such a sheltered position that no
movement of air occurs, for it is on the free circulation of
the air that we must rely for the purity of the atmosphere.
The best aspects to meet the above considerations, and
especially the question of obtaining an abundance of
sunlight, are south, south-south-east or south-south-west,
provided that there is no high hill in the immediate
neighbourhood to cut off the light from any one of them.
A south aspect is not so good in summer, as the rays of the
sun stream directly into the rooms, and are apt to make
them uncomfortably hot, but this difficulty can usually be
overcome by removing the patient to a room with a
northern aspect during the hotter months.

Position and construction of the bed-room.

The bedroom should be well away from any source
of noise, and effectually cut off from the kitchen,
water-closet, and anything likely to contaminate the
atmosphere.   It should be placed conveniently near
a well-ventilated water-closet and bathroom, so that
the patient, if feeble, is spared unnecessary exertion.
So far as the construction of the rooms occupied by
consumptive persons is concerned, everything should be
arranged so that no accumulation of dust or micro-
organisms can occur.   Precautions adopted to meet this
object involve a certain amount of expense, but the details
mentioned in the next few lines should be followed when-
ever financial considerations permit.   When there is any

right-angled junction, such as exists between the floor
and the wall, the angles should be rounded.   There
should be no right angles in anything, not even in joinery
work, whilst no mouldings or projecting architraves should
be used unless they have plain, rounded surfaces, so that
no lodgment for dust may exist.   All cracks should be
well plugged, filled in with wooden wedges, or, better,
covered with linen, which may be painted.   *It is impera-
tive that every consumptive person should have a bedroom to
himself.*

The patient should take his meals, when able to do so, in
another room where open-air conditions can be observed.
The rooms occupied by him should be on the first or on the
ground floor, so that he may not be unnecessarily fatigued
by going upstairs.   That this is important may be readily
understood when we reflect on the fact that, in raising the
body vertically, an amount of work is done which is equal
to that expended in moving the body twenty times the
distance on level ground.   In other words, a climb of
60 feet or five stories equals a walk of 1,200 feet along
level ground.

With regard to the bedroom the essential points are, General
character of
that it should be well ventilated, and capable of being bedroom.
easily flushed with a continuous supply of fresh air, readily
cleaned, and freely open to the sunshine.   It has been
found by experience that the room which meets these
requirements best is one with a southerly aspect and
having on its northern side a corridor which looks directly
on to the open, and which is not backed by another room.
A window of this corridor should be opposite the bedroom
door, and the corridor itself should be capable of having a

straight flush through it by means of doors or windows at either end. Such an arrangement is not often possible in a private house, but in every instance the bedroom selected must be capable of being readily flushed out with pure air.

Cubic capacity.

Turning to the cubic capacity of the room, it is obvious that the standards drawn up for rooms with closed windows do not apply in the case of rooms used for the 'open-air' treatment. The cubic space is of less importance than the size and position of the ventilating openings, such as the windows and doors. Within certain limits the larger these openings are the better, so that free circulation of air may take place without causing a draught or encouraging what has been called the hurricane treatment. It has been said by some authors that the bedroom should be as small as possible, as it should only be used as a shelter for the bed and as a dressing-room. Many patients, however, have to be confined to their rooms for considerable periods of time, so that their comfort in this matter must be considered. Further, if a room has the windows open constantly, it becomes to all intents and purposes a shaft. In very small rooms, with relatively large windows, the air is apt to circulate too rapidly, as is well exemplified in several sanatoria where the bedrooms have been made too small. Another objection to very small rooms is the greater proportion of space taken up by the furniture, and the consequent difficulty experienced in moving about. In the greater number of efficient sanatoria the bedrooms have a cubic capacity of 1,500 to 3,000 feet, and these dimensions may be taken as a reliable guide, a capacity of 2,000 cubic feet being, perhaps, the most suitable.

The height of the bedroom should not be less than Height.
8½ feet. There is no advantage in having the room higher
than 10 feet, although the old arguments about the air of
rooms being stagnant above a level of 11 feet do not apply
to a room which is suitable for a tuberculous individual—
that is to say, a room in which the windows are flush with
the ceiling, and are kept constantly open. If the room is
higher than 10 feet, there is more difficulty in cleaning it
methodically, and the windows are necessarily so large
that they are not easily managed.

The floor space must be sufficiently large to permit of Floor space
the position of the bed being changed if necessary, and of
the furniture being freely moved for cleaning purposes,
because the air is always more or less stagnant under beds
and other articles of furniture, as is shown by the great
tendency of dust and fluff to collect in these positions. In
my opinion the floor space should not be less than 12 by
14 feet, and the depth, measured from the northern to the
southern aspect, should not be more than 12 feet, for the
necessary sunlight can seldom penetrate sufficiently beyond
this distance.

The ventilation of the bedroom is best carried out by Ventilation.
means of large windows with fanlights and a ventilating
shaft, the simplest form of which is an ordinary chimney.

The windows should be of the French casement type, Windows.
with fanlights at the upper portion. The latter should
finish flush with the ceiling, and should open outwards.
They should also be hung from the top, so that the room
may ventilate into the outside air, and protection be
afforded against rain. The windows should, if possible,
open on to a balcony, so that the patient may readily be

moved there, and rest in a bamboo chair. Hort of Tor-
quay has devised a method of using even small balconies
in such a way that the patient gets all the benefit of
sleeping in the open, whilst he has complete protection
against the weather.   The head of the bed is wheeled out
on to the balcony, the remainder being within the room.
In this way it is possible for the patient's head to be in
the open, whilst the rest of the body, warmly covered, is
within the room.   By means of louvre shutters and a
roller blind complete protection may be obtained against
wind and rain, if necessary.   One window of the room
should be opposite to the door, so that, in summer espe-
cially, a greater amount of air can be allowed to circulate
through the room.   A fanlight over the door, finishing
flush with the ceiling, is very useful in helping the
efficient ventilation of the room.   A small electric fan
near the ceiling is also of service in warm and still
weather.

Another very convenient arrangement is a square bay-
window, at least 7 feet long by 4 feet deep, at one side of
the room, with one casement looking east, one west, and
two in a southerly direction.   Such a bay-window affords
ample space for a sofa-chair, and is an excellent place for
those patients who may be isolated and confined to bed,
and for all patients during the hour of rest before the
mid-day and evening meals.   In addition, it affords a ready
means of acclimatizing patients, especially the more
elderly ones, to an open-air life, for many people at the
outset of this treatment experience much chilliness.   No
matter what wind blows, the window on one or other
aspect of such a projection can be opened without harm,

and when there is no wind the patient can be gradually accustomed to a greater and greater supply of fresh air.

It has been shown by Rufenacht Walters and others that it is possible to keep the percentage of carbon dioxide in a room of this kind—even when occupied by a feverish consumptive patient for many days—almost as low as that of the outside air, and therefore much lower than the 0·6 per cent. adopted by most sanitary authorities for ordinary buildings, a percentage which is much too high for tuberculous individuals.

Some provision should be made in the bedroom and elsewhere against wind, rain, and excessive sun, by means of screens, which are also of service in the case of patients who cannot sleep unless the room is darkened. Venetian blinds are unsuitable, as they collect dust, and the same objection holds good for various forms of storm shutter. I would recommend roller blinds, such as are used in shops, made of greenhouse shading—a material which prevents the entrance of excessive rain, and serves to check the too rapid passage of air, although it allows free ventilation. This material is also of service in that it can readily be removed, cleaned, and disinfected.

The chief considerations to be kept in view when choosing the material for lining the walls are that it should be capable of being readily cleaned without entailing much service, and that it should not be depressing in character. The wall of a patient's room is not very liable to infection when proper precautions with regard to the sputum are employed, but the fact remains that by carelessness or accident the walls may be infected. As we have seen,

numerous researches have been carried out on this point, but practically all authorities agree with Coates, who has shown that when the walls are infected with sputum it is nearly always within 1 or 2 feet of the floor. This is an important observation, as it shows the necessity of constantly cleaning the wall in the immediate neighbourhood of the floor. Various materials may be employed for lining the walls—tiles, oil paint, ordinary distemper, Hall's washable distemper, duresco, petrifying fluid, wood, and various forms of paper, such as ordinary paper, salubra, washable linen paper, and washable muraline paper with a canvas backing. Wood is apt to crack and the joints to harbour dust, whilst it is difficult to join thick paper in a satisfactory manner. For ordinary purposes in a private house washable paper or distemper are sufficient, but these should be periodically renewed. It is best, perhaps, to paint the walls within 3 feet 6 inches of the floor—that is, the height of an ordinary chair—and to paper above this level, as the paint may then be wiped with a moist duster every day.

Floor covering.   A large number of materials are used in sanatoria for covering the floor of the patients' bedrooms, such as wood, which may be hardened and polished by a mixture of paraffin and benzine, various forms of tiling and terrazzo, fossil wood or xylolith, linoleum, cork carpet, which may be varnished, torgament—a cement which unites with wood and iron, and has incorporated with it wood-shavings, so that it is both cleanly and warm to the feet—and gypsdielen, which is bamboo incorporated with plaster of Paris, and is usually covered with linoleum or parquet. Linoleum is the cheapest of these, and the one most frequently

employed, but I have never seen it in use for any length of time without noticing a number of dusty cracks, to say nothing of the dirt which collects at the margin near the wall. Again, condensation always occurs beneath linoleum, and is one of the commonest causes of dry rot. The placing of felt beneath the linoleum does not diminish this or the tendency to the collection of dust. In a private house the most satisfactory floor is one of polished wood, great care being taken that the joints and cracks are well plugged so as to prevent any collection of dust. A curved surface at the junction of the floor and walls is useful, as the dust which inevitably collects can be readily removed.

The rooms used by the patient should, whenever possible, be lighted by electricity, as this is the only *The lighting.* illuminant which does not contaminate the atmosphere. It does not overheat the rooms, is easily regulated, always available, and saves much expense in the way of redecoration. Failing this, candles may be used, but neither gas nor lamps should be employed under any circumstances. It is as well to have an electric lamp attached to a wire, so that it can be used in any part of the room.

For many months no artificial heat is required in the *Temperature* rooms occupied by the patient, but in winter it is a good *of the room.* plan to keep them a few degrees above the outside temperature, as this not only conduces to the comfort of the patient, but also materially assists the ventilation. The temperature of the rooms at the Loomis Sanatorium is under 40° F. in the winter, and in many sanatoria, such as Linford, the Grampians, Adirondack and Boserup, the temperature is never allowed to exceed 50° F., whilst at

others, such as Rudgwick and Rossclare, no artificial heating is used at all.

As we have seen, it is important to avoid by all possible means the formation of dust. Coal fires are excellent ventilating contrivances, but there are practical difficulties in keeping them alight all night, and in any case they give rise to dust both when burning and when being cleaned, and on this account alone must be condemned. Again, when the windows are widely open, sudden gusts not infrequently blow smoke into the room. Steam or electric radiators may be employed ; both are trustworthy and easily regulated so as to keep the room at the desired temperature—that is to say, as a rule, between 50° and 55° F. By means of the electric radiator a considerable initial expense in the matter of pipes is avoided, whilst the annual cost of redecoration is diminished. Electric heating is used in some rooms at the Nordrach-on-Dee Sanatorium, and in one villa at the Nordrach Colonie, and in both cases gives satisfactory results. The position of the radiator is of importance, for no attempt should be made to warm the incoming air, as this interferes with its humidity and destroys the ozone. Indeed, if the windows are kept open, any attempt to warm the air as it enters the room ends in failure. The radiator may be placed at the bottom of the bed. If the patient is cold he may have a hot-water bottle at his feet, but after a few weeks' experience of the treatment very few patients require this.

The furniture should be light and free from unnecessary ornamentation, mouldings, or dead space. It is important that it should be capable of being easily cleaned, and that

the under-surface of any article should not escape this process. It should be attractive in appearance, for this leads to cleanliness. It is an advantage if the bed is small—not larger than 6 feet 6 inches by 3 feet 6 inches—in case nursing should be required. Feather-beds should be avoided. The position of the bed should be such that no direct current of air plays on it, but that free circulation of the air in its neighbourhood is obtained. It is undesirable to have bags and boxes in the bedroom. Consequently some form of receptacle for clothes should be provided. Chests of drawers probably meet all requirements, but many patients require a cupboard or wardrobe in addition. The former are preferable, as they do not encroach on the cubic capacity of the room, but in either case precautions must be taken against the collection of dust ; thus, wardrobes should have sloping roofs, and the interior of both wardrobes and cupboards should not be allowed to escape the daily cleansing. In addition two chairs, a bamboo or cane sofa-chair, a bed-table and washhand-stand, etc., should be provided, the latter two articles having glass or marble tops. All furniture must be so made that the lower surfaces can be easily reached and cleansed.

Carpets should be avoided, as there is no necessity for them if suitable slippers are worn, and as they tend to collect dust ; but one or two small mats of cane or other readily disinfected material conduce to the patient's comfort whilst dressing. Curtains and other hangings should be avoided as far as possible, and when used should be simple and of some washable material. Pictures add to the cheerfulness of the room, but if they are permitted

they must be carefully and thoroughly cleansed from dust every day.

The floor, lower parts of the walls, and all the furniture should be daily wiped with a *damp* duster, and every care taken against the collection or dissemination of dust—for example, by shaking the bedclothes—as detailed on p. 77.

Dining-room and passages   In addition to the bedroom, the patient will require another room for his meals. The general character of both this and of the passages and staircases which he uses are sufficiently indicated by what I have already said about the bedroom. In other words, the patient must, both in the dining-room and in the passages, always have fresh air, must be kept free from sources of infection and irritation, such as dust, and must avoid unnatural variations of temperature. The dining-room should be away from his bedroom, so that no smell of cooking can be carried there, and the passages, etc., should not be of a higher temperature than the rooms, or contain contaminated air. In treating a patient at home there is often a difficulty about the meals, for although there is no reason against his taking them in the company of his family, in many instances the other members of the family do not care to submit to the necessary conditions of ventilation. It must, however, be borne in mind that the treatment should be continuous, and that the patient must have his meals under the same conditions as those under which he spends the rest of his day.

Nursing.   As a rule there is no necessity for a patient to have a nurse, though in many cases a nurse may do much for his comfort. If he is confined to bed he should have the advantage of a trained nurse. Except when he has his

meals, it is important that he should never sit in an ordinary sized room with more than one, or at most two, other people.

The clothing should as far as possible combine warmth Clothes. and lightness. Patients should not be allowed to coddle themselves, or to wear such things as chest-protectors. They must learn to harden themselves, but at the same time they must wear sufficient to keep themselves warm. When they are taking exercise they should wear less clothing than when at rest—for example, they should not wear thick overcoats whilst walking. They must endeavour to avoid perspiration. When at rest, as in bed, they may have as many clothes as they please. It is the fashion in some sanatoria to wear no hats, and patients readily become accustomed to this, but in this matter they may safely be allowed to please themselves. In other respects the ordinary hygienic rules should be followed, and absorbent materials should be worn next the skin. Women should be taught to avoid tight-fitting corsets.

Directions about the washing and disinfection of clothes are given on p. 78. Every patient must be carefully instructed about the infectious nature of his expectoration, be provided with a Dettweiler or other flask, a spitting-cup in his bedroom, and have his sputum destroyed according to the directions given on pp. 74, 75.

The Treatment of the Patient.

The treatment of the patient may be epitomized on the Epitome of treatment. lines already laid down, as follows :

1. A continuous supply of pure, fresh air, with no unnatural variations of temperature.

2. Good nourishing food in sufficient quantity to establish and maintain the normal body-weight of the patient.

3. Constant supervision by a skilled physician who so orders the patient's life that he is enabled to avoid anything which is harmful or leads to an exacerbation of the disease, and, at the same time, to take advantage of everything which helps the process of repair, or develops the power of resistance.

The patient must be made to understand that the arrest of his disease rests primarily with himself, and on his loyal co-operation with his medical adviser. He must thoroughly comprehend that the details of the treatment are of the utmost importance, and that it is only by a punctilious observance of them all that he can expect to be restored to a sufficient degree of health to resume his ordinary form of life.

It will conduce to brevity and be convenient if I now give a brief outline of the daily routine of a patient whose disease is becoming quiescent and who is allowed to take active exercise, in order that the general lines of the necessary treatment may be clearly grasped. I shall then discuss with greater detail the principal questions involved, pointing out the constant variations which have to be made in the treatment according to the particular phase of the disease.

Daily routine. The following is an outline of the daily routine observed at Nordrach : The patient is called at seven in the morning,

and in the colder months the windows of his room are
then closed, in order that the room may be comfortably
warm whilst he dresses. This shutting of the windows
at this time serves another purpose, in that the air of the
room immediately tends to become ' stuffy' to those ac-
customed to open-air methods. Consequently there is a
direct incentive to patients to get up. The patient then
takes his temperature (rectal), and rises not later than
7.30, and then has a shower-bath at a temperature, in
most cases, agreeable to himself. He must avoid over-
exertion in drying himself. On completion of his
dressing he should open the windows. Breakfast is at
8 o'clock. Directly after breakfast, or at 8.30, the patient
starts out for his morning walk, the length of which is
graduated according to his condition. He walks deliber-
ately, avoiding any strain, dyspnoea, or perspiration, until
he has arrived at his destination, and waits there resting
in the fresh air, but protected from the wind, until it is
time for him to start home again. At 11.45 he must be
in his own room, where the windows have shortly before
been shut, and must take his temperature. In five or ten
minutes he should open the windows. Between 12 and
1 o'clock he lies resting, *and alone*, at full length on a
sofa-chair near the window. At 1 o'clock he leaves his
bedroom or shelter and has luncheon, the principal meal
of the day, with his family. Not later than 2.45 he must
start on his slow afternoon walk, which is the shorter
walk of the day. He rests, as before, when he arrives at
his destination, and slowly returns, so that he reaches
home at 5.30, or, if it is very cold, at about 4.45. He
again takes his temperature, opens the windows which

have been closed shortly before his return, and rests alone until dinner-time. At 7 o'clock he joins his family at dinner. After dinner he may spend half an hour to an hour in the dining-room, or preferably in some suitable recreation-room, under open-air conditions. The patient retires to his own room at 9 o'clock, opens the windows, and takes his temperature. He should be in bed at 9.30, or at latest 10 o'clock.

Each patient should be weighed once a week, at the same hour and under the same conditions. Every fortnight his chest should be thoroughly examined—there is seldom much to be gained, save in acute cases, by a more frequent examination—and every month his sputum should be tested. It is important that the *temperature should be taken in the rectum*, as otherwise significant changes fail to be observed, and the patient is allowed to do too much. This has been denied by some authorities, but I am satisfied that it is a true statement of fact. When the temperature is high, it is in my experience a matter of comparative indifference whether the temperature is taken in the rectum or in the mouth. When, however, the temperature is raised one to two degrees above normal, the rectal readings are much more reliable than the oral. Patients should endeavour to avoid attempts at coughing, and should be taught that every cough avoided is something spared to the lung. If they persevere a little, they will soon find that it is possible to keep the cough in check.

The above outline of the daily routine refers to a con-
Rest and exercise.
valescent patient able to take ordinary exercise. The relative proportions of rest and exercise, as we have seen,

vary with the patient's condition, and have to be carefully
regulated from time to time, and suited to the individual
requirements.   This regulation, indeed, is one of the chief
duties, and I may add anxieties, of the medical man in
attendance on a consumptive patient.   All patients should
be kept rigidly at rest in bed whenever they are unable to
take solid food.   Under all conditions it is important
that every patient should have one hour's absolute
rest alone before both the mid-day and evening meals,
so that he may approach his food with a good appetite,
and not in a more or less exhausted condition.   The
effect of muscular fatigue both on the appetite and
on digestion is well known, and it is important that
a patient should approach his meals with his powers
of digestion and assimilation unimpaired.   Again, the
majority of patients should be kept at rest during the
first week of treatment, as in this way they are acclimatized
more readily and safely to the altered conditions which
an open-air life entails.   Apart from these considerations,
we must be guided in apportioning the relative amount of
rest and exercise in individual instances by the tempera-
ture, the reaction and general condition of the patient,
and by certain other indications, but it must be remem-
bered that there can be no rule, that the individual
peculiarities of the patient must always be the determining
factor, and that we must have recourse to experiment
within reason in almost every case.   In my opinion *some
form or other of exercise should be prescribed as soon as
it can be taken without harm*—that is, without causing
exhaustion or fever.   Our object is to place our patients
in such a condition of health that their temperature is

about 97·8° F. in the morning and 98·4° F. in the evening.
When the temperature is above these points, exercise should
be prescribed with caution.   As a general rule, it may
be said that a temperature in the morning of 98·4° F.,
which previously has been subnormal, should act as a
signal to the physician to watch the case more closely
and to prescribe exercise with greater care.   Also, if the
morning temperature is 98·6° F., the patient should remain
at rest (*i.e.*, refrain from exercise) until it returns to the sub-
normal ; if the morning temperature is 100° F., the patient
should remain in bed until it returns to the normal ; if the
evening temperature is above 99° F., the patient should re-
main at rest until it returns to 98·6° F. ; and if the evening
temperature is 100° F., or more, the patient should remain
in bed until it is normal.   In many cases when the tempera-
ture is higher than 98·6° F. in the morning, and more than
100° F. in the evening, the patient should rest in bed all
day, and should not leave his bed until his temperature
has been below these levels for at least a week.   In some
instances we may find that these rules are too rigid.   If
a patient is not making headway under these conditions,

Conditions   we may try an experiment.   We may start with massage
for exercise   exercises or resisted movements, and note whether these
lead to any exhaustion or increase of fever.   If they do
not, we may then allow the patient to take short walks of
twenty or thirty yards once or twice a day, and again
watch the result.   If the result of this experiment is
satisfactory, we may gradually increase the length of the
walk on the level and eventually prescribe uphill exercises.
It occasionally happens that a patient with an evening
temperature as high as 102° F., who fails to make any

progress whilst kept at rest, loses his fever, and becomes
in every way stronger when permitted to take gentle exer-
cise. Or, again, we may find that febrile patients who do
not improve when kept at rest may do so when they are
allowed to take a slight amount of exercise in the early
hours of the morning—viz., between 4.30 and 5.30 a.m.,
as was originally suggested by Bodington. The early
morning air undoubtedly leads to successful results in some
instances, though we do not know of any explanation for
its success.

When a patient is permitted to take exercise, the Further
temperature immediately after the walk must not, as a contra-
rule, be higher than 100° F. If the temperature is raised indications of exercise.
to a higher point than 100° F., or if it fail to sink to
normal within twenty minutes, or if there is any sign of
exhaustion, the amount of exercise has been too great,
and the patient should rest for the remainder of the day,
whilst a shorter walk should be prescribed on the follow-
ing morning. In this manner the amount of exercise
which can be taken without the temperature rising
above 100° F., or remaining at that level for more than
twenty minutes when the patient is at rest, can be deter-
mined.

Further, if we find by experiment that exercise causes a
marked increase in the pulse-rate, or brings on dyspnœa
or profuse perspiration, then it is contra-indicated.
Exercise should also usually be prescribed in a very
guarded degree if there is much dyspepsia or continued
loss of weight. It should not be indulged in if there is
much cough or abundant expectoration, especially if it
tends to increase these symptoms. It should not be per-

mitted if there is diarrhœa, nor if the circulation is feeble,
nor if acute disease, such as rapid softening or acute
pleurisy, is present. Again, if there is profuse hæmoptysis
absolute rest is indicated, though, on the other hand,
we may sometimes find that a small amount of exercise
benefits those patients who suffer from frequent slight
attacks of hæmorrhage, or those whose sputum is con-
stantly tinged with blood.

We see, then, that we have no absolute guide to
determine when we should prescribe exercise, and that,
although in many cases certain indications, especially the
temperature and the general condition of the patient,
afford us important information, yet in a large number of
instances we can only decide the question by means of
experiment, and by observing the reaction of the patient
to different degrees of exertion. We have to deal with
individuals who may be allowed to walk five or more miles
twice a day, with others who must be kept alone and at
rest in bed all day, and with others who may take a slight
amount of exercise in the morning, but who must rest for
the remainder of the day.

If rest is prescribed, when should it be taken? This
question has been largely answered in the previous pages.
I need only say here that in all cases before meals,
and in cases where the fever is high or there is great
exhaustion, the rest must be absolute and in the recum-
bent posture—the patient not even being allowed to
converse—either in a bedroom or in a suitable shelter
under open - air conditions. When the necessity for
absolute rest is not so imperative, patients may be
allowed to lie out on chairs in the garden and see one or

Must decide
by experi-
ment.

When should
rest be
taken?

more friends, provided that they are duly protected from
the wind and excessive sun or rain.

When exercise is prescribed, what form should it take ?
This, again, has already been largely answered. I would
repeat here that the best form of exercise for tuberculous
individuals consists of very slow uphill walking. This has
two advantages, in that it is easily regulated, and
that it acts as a heart tonic. The patient should
walk to some appointed place, and then should have
a prolonged rest. The pace should not exceed two to
three miles an hour in the more convalescent cases,
and in more feeble individuals should resemble that of the
snail. Patients should be warned not to wait to get tired
before they rest, but should rest before they are tired ; in
fact, exercise must never be pushed to the point of fatigue.
If caught by the rain, they must not hurry or run, because
to do so induces a greater rate of respiration, and so throws
an undue strain on the lungs, whilst the body temperature
is apt to be raised. At first patients may walk on level
ground, and then on graduated ascents, care being taken
that the ascent should be at the commencement of the
walk, when they are fresh, and the descent at the end,
when they may be getting tired. A roll of rubber
should be carried, so that whenever they begin to
feel tired or at all short of breath they can sit down
at once.

Exercise should, then, be taken whenever it does no
harm ; it should also be taken under all conditions of
weather, except in stormy winds. Patients must become
accustomed to rain ; but there is no reason why they
should not be protected by suitable clothing, whilst if

they get wet they may change their clothes when they return home. In windy weather they should have recourse to some open-air shelter. Convenient forms of shelter in which the periods of rest, or even sleep, may be spent are made of wood at a moderate price; they should be as simple in design as possible, capable of being readily disinfected and cleansed, and so placed as to allow a free circulation of air, and to take advantage of the natural beauties of the country. They can be made to turn on a pivot, so that protection is obtainable from wind in any direction.

Other forms of exercise.   With regard to other forms of exercise, the same general rules·must be followed. Until the disease is quiescent, patients should refrain from any form of exercise which is likely to cause strain, or requires a sudden effort involving the use of the arms to any marked degree, or is likely to cause undue excitement. As before, each case must be studied on its individual merits, but patients who are allowed to walk two or three miles may usually be allowed to ride or skate, provided that due care is taken. Uphill walking is the most satisfactory form of exercise, but it is apt to be monotonous. When the patient is doing well on graduated walking exercise, and arrest is in progress, he may be allowed to adopt some form of graduated labour, such as Dr. Paterson has shown us to be productive of very good results at Frimley. In giving this advice I must again emphasize the warning that overexertion is at all costs to be avoided, as it is the cause of most relapses in consumption, and that in prescribing exercise we must proceed with the utmost caution, and *gradually* increase the exertion if it is giving good results. We must proceed

slowly, and always avoid prescribing exercise which can possibly do harm.

Dr. Paterson's exercises are referred to in more detail on p. 111, but for convenience of reference they are reproduced here. They were devised for members of the working classes, but there is no reason why patients of any class of life should not perform them. As the disease becomes definitely arrested, patients may gradually be allowed to indulge, with due precaution, in more active forms of exercise, such as golf; or they may cycle, provided they go slowly and do not impede the movement of the chest by leaning forward. Lawn-tennis, cricket, and other games involving much exertion, should be restricted to those who are no longer patients—that is, those in whom the disease is cured.

Dr. Paterson prescribes exercise and labour for two periods daily, each of two hours' duration. The patient is first placed on grade 1, and then, as improvement shows itself, successively on grades 2, 3, etc. If the work of one grade is found to lead to rise of temperature, increase of cough, or other bad symptom, the patient is at once replaced on a lower grade. The different grades are as follows : (1) Slow walking exercise, beginning at two miles a day and gradually increasing up to ten miles a day; (2) picking up fir-cones and firewood in the grounds, and carrying a half-basket (weight, 11 pounds) to the stack; (3) carrying a full basket of firewood and cones (weight, 16 pounds); (4) carrying a half-basket of gravel or stones from the gravel-pit to the place where paths are being made or repaired (weight, 21 pounds); (5) carrying a basket of gravel or stones,

the weight of which is gradually increased up to 38 pounds;
(6) rolling the grass or gravel (sixteen men pull a roller
weighing 15 hundredweight) ; (7) digging ground already
broken ; (8) mowing grass with a lawn-mower; (9) digging
unbroken ground ; (10) the same as under (9), but for
six hours daily instead of four hours—*i.e.*, the hours
usually spent at rest are spent in labour.

No patient is classified on discharge as ' arrested,' unless
for three weeks continuously he can pass one or other of
the following tests :

Test A : For a Patient who earns his Living by Manual
Labour.—To be able, on an ordinary diet and without rest
hours, to use a pick and shovel of the full size and weight
for six hours daily, and to maintain his health.   The
shovels and spades are in three sizes, weighing 2, 4, and
6 pounds respectively.   The picks vary from 3 to 7 pounds
in weight.

Test B : For a Patient who does not earn his Living by
Manual Labour—*e.g.*, Clerks, Shopmen, or Salesmen.—To
be able, on an ordinary diet, to perform the labour of
grade No. 6 or No. 7 for six hours daily for three weeks,
and to maintain his health.   These patients are, as a rule,
gradually brought up to No. 9, and when it is found that
they can do this work they are put back to No. 6 or No. 7.
The theory is that a man doing the work described under
No. 9 or No. 10, who, on discharge, will engage in work
involving but little bodily exercise, would suffer in health
from such an abrupt transition.   Further experience is,
however, necessary upon this point.   In some cases it is
found that patients are unfit for No. 9, but that they can
be raised to a standard of labour which is equal to their

ordinary work. These patients are tested before discharge on the grade to which they have attained, but they are not, as a rule, classified as ' arrested.'

Everything possible must be done to relieve the monotony of our patient's existence, but in the acuter stages amusements or anything of an exciting nature should not be allowed, any more than in an attack of typhoid fever or pneumonia. There is no hardship in foregoing amusements for a few months, if by so doing health can be regained.

Sufficient has been said in discussing the principles of the treatment to show that during certain phases of the disease disastrous effects may follow even slight indulgences, and those writers who have recently complained of the absence of amusements in sanatoria have entirely failed to appreciate one of the important details of the treatment. As the disease becomes quiescent more latitude may be permitted, but it must be remembered that such simple things as playing the piano, cards, or chess, or in some cases even reading certain literature may cause a rise of temperature, and thus act detrimentally on the patient, and favour the progress of the disease. Consequently, when amusements are permitted the physician must watch the effect.

Smoking may be allowed in the open air so long as it does not produce coughing, or is not indulged in to excess. No smoking indoors should be allowed under any circumstances. Pipes and cigars are better than cigarettes. The practice of inhaling should be avoided.

Consumptive patients must be persuaded by every possible means to eat sufficient food to replace not only

the ordinary tissue waste and the extraordinary tissue waste due to their disease, but also to enable them to gradually put on weight, until they reach a limit somewhat above the average weight for their height and sex. We generally find that consumptive patients regulate the amount they eat entirely by their appetite, and though many have surprisingly good appetites, yet the majority have but little desire for food, and it requires no little art and persuasion to make them take the necessary amount. I often tell my patients at the Brompton Hospital that unless a fire is replenished it goes out, and that in a

Necessity for eating.

similar way a large quantity of food is essential to their health. Patients, in other words, must not be guided by their appetites, and this is one reason why tuberculous individuals should spend some time in an open-air sanatorium, where they can be trained to eat large quantities more easily than at home, for they not only eat under the immediate eye of the physician, but they see other patients, worse than themselves, negotiating large quantities without discomfort. At home they must be put upon their honour to eat everything given them, and their friends should see that all directions on this point are loyally carried out. With fresh air and exercise, and with rest before meals, the appetite is good, and patients seldom have any difficulty in eating the necessary quantities. If they have, they must still be made to eat what is given them, even if they take two or more hours in doing so.

Quantity of food.

With regard to the quantity of food, I may say at once that there has been gross exaggeration as to the amounts given at Nordrach and other sanatoria, and the terms 'stuffing' and 'overfeeding' have been applied without

sufficient justification. It is true that patients at these institutions have to eat far more than they would take if they followed their own inclinations—far more, indeed, than medical men are generally in the habit of prescribing for consumptive patients. The amount eaten, however, is not much greater than an ordinary healthy individual consumes under ordinary circumstances. Thus, when I was at Nordrach for some weeks I never had the slightest difficulty in eating the helpings given me, although these were somewhat larger than those of the patients immediately beside me ; nor, indeed, did I suffer from any discomfort—although I am naturally a small eater. It is possible that, whilst small quantities of food tend to irritate the stomach or to remain undigested, larger quantities, by reason of their bulk, tend to stimulate the muscles and glands of the stomach, and so lead to a better assimilation of food. The preconceived ideas that the stomach of a consumptive individual is so atonic that these quantities of food necessarily lead, as suggested by Clifford Allbutt, to a detrimental dilatation of the stomach, have been proved to be erroneous. In fact, the results of this method of treatment almost make us doubt the existence of dyspepsia in tuberculous patients when they are treated on rational lines.

The following conclusions, formed by Goodbody, Bardswell and Chapman, on the results of a chemical and experimental investigation of the effect of various diets in six cases of pulmonary tuberculosis may be quoted, as they afford us much useful information : *Experiments on diets.*

‘1. Tuberculous patients show very satisfactory results, both clinically and experimentally, when their diets are

slightly increased in amount above what they have been in the habit of taking before coming under treatment. It is evident that the state of the appetite gives too low an estimate of their requirements. While comparatively large diets are well borne by those who are much below their normal weight, they are not so well tolerated by, nor do they give such satisfactory results in, patients with a normal weight in whom the disease is arrested. In the case of all patients—however much they are below their proper weight—very large diets give unsatisfactory results, as, although weight is gained, it is only at the expense of the general health, as indicated by failure of appetite, more marked digestive disturbance, increased intestinal putrefaction, and, in some cases, vomiting.

'2. Diets of medium proportions, but still large, give the best results, and can probably be continued for an indefinite period.

'3. The digestion both of nitrogen and fats is good even in the case of patients with high fever. The absorption of fats, indeed, is excellent, even when very large quantities are given—*e.g.*, with an intake of 231·32 grammes 96·41 per cent. was absorbed.

'4. It is noticeable that the patients complained of the least discomfort on those diets which gave the best experimental results, whilst the onset of severe dyspeptic troubles usually coincided with a deterioration in the experimental results.'

General arrangement and character of meals.

The general character of the food for the majority of the patients does not differ much in existing sanatoria, but the times at which it is given do. Thus, to quote Knopf, 'the meals given the patients at many European

sanatoria are as follows : in the morning, 7.30 to 8.30 a.m., they have bread-and-butter and honey with cocoa, coffee, or chocolate, and two or three glasses of milk taken slowly. At ten o'clock they have bread-and-butter, cold meat, fruit, etc. ; at one o'clock the dinner—soup, fish, three kinds of meat, vegetables, salad, preserves, dessert and fresh fruit, with one or two glasses of wine ; at four o'clock they have a glass of milk with bread-and-butter ; at half-past seven thick soup, meat and potatoes or rice, cold meat, bread-and-butter, salad and cooked fruit, are given, with again one or two glasses of wine ; at nine o'clock they have a glass of milk with two or three spoon-fuls of cognac.' Personally I much prefer, and have seen better results from, the system in which longer intervals are allowed between meals, and no food or drink is allowed at less intervals than five hours. By this means the digestive and assimilating powers are enabled to rest, and so to return to their work with renewed vigour. It naturally happens that exceptions have to be made in many instances, but our aim should be to do with as few ' meals between meals ' as possible. In the system I follow three meals are given every day, and nothing is allowed between times. Breakfast at 8 a.m. consists of tea or coffee, a large quantity of butter and bread (not new), eggs, fish, meat, such as ham, or tongue, or sausage, or occasionally raw scraped meat or cured salmon, with a pint of milk. Dinner at one o'clock consists of two hot courses of meat, or sometimes one of fish and one of meat, about 4 to 6 ounces of each, with a large quantity of specially selected potatoes, containing an abundance of carbohydrate material, with fresh green vegetables or

rice, and an abundance of excellent fat-containing sauces. The third course may be pastry, or some form of farinaceous pudding ; on alternate days this may be replaced by fruit, or ice-cream may be given. In addition the patient has a pint of milk, and at the end of the meal may have a cup of coffee. Supper is at 7 p.m., and consists of one hot course of meat with potatoes and vegetables, and one cold course of meat or fowl, with an abundance of bread and butter and cheese, and a pint of milk. At the end of the meal a cup of tea is allowed if the patient wishes for it.

General character of the food. Individual and national peculiarities must be considered, and in every case the food should be as varied as possible. It should be the best procurable, and must be always cooked and served in as appetizing a manner as possible.

It should, further, consist of an abundance of proteids, carbohydrates, and fats, given in a proper proportion.[*] Carbohydrates are an important item. A large quantity of fat-forming food, such as milk, butter, fat, and potatoes, should always be given in as pleasant a guise as possible, suitable fat-containing sauces being an important adjunct to the treatment. Until the normal weight has been regained, at least 3 pints of milk should be taken by the patient each day, but when the weight is satisfactory the amount of milk should be gradually diminished. ·Each patient should eat at breakfast a large quantity of bread very plentifully covered with butter, and smaller

* For further details see author's article on the ' Principles of the Dietetic Treatment of Pulmonary Tuberculosis' in the· *Practitioner*, vol. lxxiv., pp. 38-49.

quantities at his other meals. Again, both at the mid-day and evening meal at least sufficient potatoes to cover half an ordinary plate should be eaten. Both veal and pork are useful, as they contain much fat, and do not appear to lead to dyspepsia in consumptive patients. Bardswell and Chapman have shown by scientific experiment that very large diets do not give good results. They have further shown that comparatively large diets are well borne by those who are much below their normal weight, but that they do not give such good results in patients with a normal weight. These authors hold that a man, I stone under his normal weight of II stone, who is capable of taking some exercise, should be given 120 to 160 grammes of proteid, 140 grammes of fat, and 270 grammes of carbohydrates daily.

They divide the food as follows:

7.30.—Milk, ½ pint.
8.30.—Milk, ½ pint; bread or toast, 2 ounces; butter, ½ ounce; 2 ounces fish or bacon, etc., and an egg.
11.0.—Milk, ½ pint.
LUNCH, 1.30.—Milk, ½ pint; bread, 2 ounces; butter, ½ ounce; fish, 2½ ounces; meat, 3 ounces; milk puddings, 5 ounces.
DINNER.—Similar to lunch, but meat, 2 ounces.
10.30.—Milk, ½ pint.

Cornet, who adopts a somewhat lower fat standard for the diet in health than these authors, is in the habit of prescribing for his patients on the following lines:

FIRST BREAKFAST, 7 O'CLOCK.—¼ to ½ quart milk (cocoa or coffee), with one or two eggs stirred in, or gruel, or meat, bacon, bread-and-butter.
THE SECOND BREAKFAST, 9 TO 9.30.—¼ to ½ quart milk, or 3 ounces strong wine (sherry, port, marsala), bread-and-butter.

Noon Meal, 1 o'clock.—Soup, entrée, fish, roast venison, fowl, with vegetables, preserves and salad, pudding, bread, butter, and cheese, 3 ounces red wine, or $\frac{1}{2}$ pint beer.

Afternoon Meal, 4 o'clock.—$\frac{1}{4}$ to $\frac{1}{2}$ quart milk (cocoa), with one or two eggs stirred in, bread-and-butter (honey).

Supper, 7 o'clock.—Roast meat, vegetables, cold meat (ham), roasted potatoes, bread-and-butter, 3 ounces wine, or $\frac{1}{4}$ to $\frac{1}{2}$ quart beer or milk.

9 o'clock.—$\frac{1}{4}$ to $\frac{1}{2}$ quart milk, one swiebach, cakes or bread.

Lucas gives the amount of the various forms of food which are necessary as follows:

Breakfast.—Half a pint of porridge, with 2 ounces of sugar, two rashers of bacon, and two eggs (or chop, steak, or fish); bread, 4 ounces; butter, 2 ounces; $\frac{1}{2}$ pint of tea or coffee; milk, 1 pint.

Mid-day Meal.—Soup (optional); fish, 3 ounces (or poultry), with butter, 2 ounces; two or three slices of meat, 4 ounces; potatoes, 4 ounces; cabbage and other vegetables, 4 ounces; pudding (various kinds), 6 ounces; cheese, 2 ounces; bread, 4 ounces; butter, 2 ounces; milk, 1 pint.

Evening Meal.—Two eggs (or cold meat or fish); bread, 6 ounces; butter, 2 ounces; jam; $\frac{1}{2}$ pint of tea; milk, 1 pint.

The following examples of menus for the chief meal of the day at existing sanatoria may be of service in indicating the general character of the food:

Nordrach Colonie, *February* 4, 1901.—Hot stewed tongue, asparagus, a large plateful of potatoes; hot veal, more potatoes, and salad; pastry and cream; bread, butter, and coffee; 1 pint of milk.

February 7, 1901.—Turbot and potatoes; lamb and potato salad; apple cake, bread, butter, coffee, and 1 pint of milk.

Heilanstalt Falkenstein (Taunus).—Nudelsuppe. Delicatess Häring. Lendenbraten. Kartoffeln. Essigzwetschen. Wirsing-Fleischröllchen. Poularde. Salat. Compot. Reis mit Aepfel. Nachtisch.

Heilanstalt Falkenstein (Taunus).—Perlgerstensuppe. Schellfisch. Butter. Kartoffeln. Schmorbraten. Maccaroni. Preisselbeeren. Spinat. Pommersche Gänsbrust. Hahnenbraten. Salat. Compot. Haselnüss Creme. Nachtisch.

SANATORIUM DE BEAUREGARD,

Près Montana-s-Sierre.

DÉJEUNER.

Du 5 Janvier, 1902.

Hors d'œuvre.
Potage crême d'orge perlé.
Terras à la Meunière.
Pintades à la Demidoff.
Tête de veau en tortue.
Macédoine de légumes au beurre.
Roastbeef.
Pommes château.
Glace au Moka.

On such a diet it is not uncommon for patients to add one-quarter to one-third of their total weight, and to retain this. I have known patients weighing 100 pounds to gain 2 stone in less than two months. The quantity of food given, however, and especially the amount of milk and other fat-forming foods, must be diminished when the weight has become somewhat above the normal, care being taken that sufficient food is given to maintain the weight once it has been established. If the quantity of food is not diminished in this way, the progressive gain in weight consists largely of fat rather than muscle or bone, and is apt to be readily lost; whilst in some cases the amount of fat is so large that the patient is inconvenienced by it, and suffers from dyspnœa on any slight exertion. This undesirable state of affairs can usually be avoided by diminishing the amount of food at the proper time, and by increasing the amount of exercise.

Unfortunately, we are constantly meeting with cases in which the above simple rules cannot be followed. For

Quantity of food to be diminished when normal weight regained.

example, febrile patients may be unable to take solid food, or, if they do, may immediately vomit, whilst many others suffer from anorexia or dyspepsia. It has been satisfactorily demonstrated by Walther that the readiest and most efficacious way of reducing the fever of consumption, however high, is by means of a sufficient quantity of solid nourishment. The above, or even larger quantities, should be given, whenever possible, at the same intervals. In many instances patients with fever declare that they cannot take solid food in such quantity, but if they are made to understand that success in this matter affords the one chance of their recovery, and if the person in authority, whether doctor or friend, only exercises sufficient perseverance, it may be spending two hours or more to get the necessary amount taken in teaspoonfuls, the majority of patients find that they can retain and digest the necessary quantities of food, and that in a few days or weeks they are able to do so with a certain amount of relish. In other instances, however, the necessary amount of solid food cannot be taken or retained. The effect of smaller quantities at more frequent intervals may then be tried, or we may have to trust entirely to a fluid diet. We should exercise all our ingenuity in this matter, our aim being to get more food-stuffs taken than is merely necessary to compensate the tissue waste, and, as soon as possible, to get the patient to take an ordinary solid diet. We must rely on such things as milk alone, or with barley-water, rice, and barley-soup, peptonized milk, koumiss, eggs in various forms, albumen-water, oysters, underdone meat, raw-meat juice, and preparations such as pano-peptone, protene, plasmon, and tropon, with which we

are familiar in the ordinary treatment of disease. If these measures fail, we must resort to Debove's plan, and feed the patient by means of a stomach-tube, as food given in this manner is often retained and digested. Similar measures should be adopted if dyspepsia or vomiting is a troublesome feature, and in addition alcohol may be given, or the remedies referred to on pp. 215 *et seq.* may be tried. It must, however, be remembered that in such cases we must rely on the fresh air, rather than on medicine, to relieve the disordered stomach.

Debove's method.

A few words may be said about the administration of alcohol in tuberculosis. In those cases where the digestion is good, the temperature is normal, and exercise is possible, there is no necessity to give alcohol, although small quantities in many instances are of undoubted benefit. Most patients, therefore, may be allowed a glass of beer or wine, preferably claret, with their mid-day and evening meals, and the majority find no difficulty in taking either beer or claret in addition to their milk. In some instances small quantities of alcohol will diminish the appetite and retard digestion, but in most cases they promote both. Experience has shown that alcohol is of the greatest possible service when fever is present. It saves the body proteid, stimulates the appetite, and, in small doses, hastens gastric digestion. It facilitates the absorption of fat, and tends slightly to lower the body temperature. In addition, it stimulates the heart and the central nervous system, and favourably affects the night-sweats and the sleeplessness. When solid food cannot be taken, alcohol is our sheet anchor. Physicians like Brehmer and Dettweiler, as the outcome of a very large experience,

Alcohol.

were in the habit of prescribing alcohol to a considerable extent. The alcohol should be pure and of the best quality. Red wine may be given with great effect in certain cases of tuberculous diarrhœa. When the digestion is impaired, sound cognac, well diluted, is the best form of alcohol. When vomiting is present, a good dry champagne gives perhaps the best results. Beer and stout are more useful in the afebrile forms of the disease. With regard to the amount of alcohol to be given, this must depend upon the individual case. Nothing but good results from the administration of large quantities when fever is present, so long as the pulse is becoming slower, the appetite better, the skin and tongue moister, and the patient quieter. Careful examination of each individual case will show whether this food is overstepping physiological limits, and so causing pathological effects or intoxication.

Weight.   The weight of the patient affords, within limits, the best guide as to whether the diet is a suitable and satisfactory one, and also as to the general progress of the patient. Consequently, every patient should be weighed in the same clothes each week on an accurate machine, and a record kept. It is important that the hour of weighing should always be the same.

CHAPTER VII

OTHER FORMS OF TREATMENT

IF we read the history of the treatment of pulmonary consumption in early days, as recorded by Sir T. Young, we find, for example, that Pliny enumerates a variety of _{Pliny} specifics for the disease with an almost superstitious credulity. After mentioning the pectoral virtues of gum ammoniac, he observes that 'woods affording an abundance of resinous effluvia are very beneficial to the consumptive, even more so than a voyage to Egypt or a course of milk in the mountains.' He praises the juice of plantains, and the tincture of betony with honey. He says that 'in Achaia a wolf's liver infused in wine, the lard of a lean sow fed on vegetables, and asses' flesh together with a broth are used for curing consumption, as are the smoke of dry cow-dung drawn through a reed, and the tips of bullocks' horns burnt and powdered and mixed with honey. Goat's fat in gruel or with honey and water and a little rice is recommended by many.' This very respectable author further says : 'Consumption in the last stage has been cured by the fat of a mountain goat taken in milk. Others employ the lungs of a stag with straight horns, smoke-dried and triturated with wine.' If we turn to Paracelsus, in the sixteenth century, we find that 'the _{Paracelsus}

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diet is of the greatest consequence, and should consist of liquorice, polypody, lentils, raisins, lettuces, radishes, cabbages, beet, and other vegetables. An ointment is prescribed for universal friction morning and evening, and the powder diacoraliorum, containing crude antimony and crocus marsh, is to be given in pretty large doses until the spongy froth in the urine disappears, and an ointment, chiefly composed of the fat of field-mice, is recommended as an experiment with the same limitations. The patient is to try the use of a bath containing a decoction of herbs with sulphur. When the disease has once been cured it is said not to return.'

This whimsical mockery of medical science sounds ridiculous ; but is it more so than the practice which is followed in some instances, even at the present day, of prescribing as many as half a dozen mixtures for some unfortunate patient to take within the twenty-four hours—some to increase the appetite or the action of the heart, others to allay the cough or diminish the perspiration, and yet others to act as 'specifics' or to bring sleep at night ?

Peculiar specifics.

Among the remedies which have been vaunted as specifics for the treatment of consumption during the last fifty or sixty years, I would mention curls made of blotting-paper, impregnated with ammonium chloride, inserted into the nostrils ; injections of sulphuretted hydrogen into the rectum, repeated bleedings, debilitating drugs such as antimony ; the grape cure, compressed air and hot air—a wonderful record. Finally, we have what is in vogue so much at the present day—namely, the use of all sorts of antiseptics, the result of this in many

instances being, as Dr. P. W. Latham said in his Harveian oration, that 'the patient rather than the bacillus succumbs.' It has been asserted that each of the above measures has produced numerous cures of tuberculosis in all its stages, but it seems to me that the only deduction we can draw from the results obtained is that pulmonary consumption must indeed be a curable affection when it withstands these varied forms of treatment.

It is an unfortunate fact that, as yet, with the exception of the hygienic measures already discussed, no method of treatment, and certainly no medicinal remedy, can be regarded as a specific for tuberculosis. As, however, several methods of treatment, asserted by their followers to exert a specific action on the disease, are in vogue at the present day, I must briefly discuss them, especially as some of them, although they do not act as specifics, are useful adjuvants in the treatment of this disease.

The results of sanatorium treatment in a variety of climates have shown that the old ideas of a particular Climate. climate or altitude being a specific for pulmonary consumption are erroneous, and have proved that climate is only one, though an important, factor in the treatment. Climate in itself is not everything ; for instance, as Osler points out, in the Blood Indian Reserve of the Canadian North-Western Territories there were, excluding diseases of infancy, 127 deaths—or 23 per cent. of the total rate— from pulmonary consumption during six years in a population of about 2,000, and that in a tribe living in one of the finest climates of the world—at the foot-hills of the Rocky Mountains. Again, as I have already said, tuberculosis is rife amongst the watchmakers of the High

Alps, whilst sanatorium treatment is successful in low-lying Holland. The question of climate is, however, as I show on pp. 226 and 227, of importance in the treatment of advanced consumption and when certain conditions, such as emphysema, complicate the disease ; but with these exceptions any climate will do for the treatment of tuberculosis, *provided that the air is pure and bracing.*

Sea-voyages.   Some authorities are in the habit of prescribing sea-voyages for persons suffering from tuberculosis, and there can be no doubt that sea-air is of service. This is chiefly due to the fact that sea-air is pure and free from contamination. Many individuals derive great benefit from this form of treatment. In such cases, however, the disease is usually limited in extent and recent in origin, and, as is now well understood, such cases do well under other conditions.

In my opinion, only those patients in whom the disease has not made much progress should be sent on a long sea-voyage, and then only in sailing vessels in which suitable accommodation and food can be obtained, as the conditions found on board most steamships, such as the stuffy air under deck and the great variations of temperature, are wholly incompatible with hygenic treatment. Patients with advanced disease should never be subjected to the hardship of a long voyage. Further, several medical officers of the Peninsular and Oriental Steamship Company have informed me that they are convinced that patients with any tendency to hæmorrhage should stay on shore. This is the opinion of many observers, and is probably true in the majority of cases. As in other questions connected with the treatment of

tuberculosis, no absolute rule can be laid down, as is well shown by the following case :

A gentleman who had frequent attacks of hæmorrhage, Case. one of which was so severe as to threaten a fatal issue, derived so much benefit from short sea-voyages that he was sent round the Cape to India and back. The disease was arrested so thoroughly that he was able to resume work, and two years after to marry. He is now, forty years later, alive and well.

In 1890 Koch announced that he had been able to Tuberculin. produce a substance which was capable of rendering healthy guinea-pigs immune to tuberculosis, and of bringing about complete arrest of the pathological ·processes in guinea-pigs already suffering from advanced and generalized tuberculosis, without causing any harmful effects. This substance was a sterilized glycerine extract made from pure cultures of tubercle bacilli. The reasons which caused Koch to search for a specific in this direction appear to have been that (1) in the case of many diseases animals can be made immune by the injection of gradually increasing doses of the toxin of the particular disease ; (2) such immunity is most safely brought about by the injection of gradually increasing doses of the products of non-virulent bacilli, or by injecting these bacilli themselves ; (3) when tubercle bacilli are cultivated for several generations on media they tend to lose their virulence. In other words, Koch drew on his knowledge of immunity, and experimented to see whether the products of non-virulent tubercle bacilli would, when injected in gradually increasing doses, bring about immunity from tuberculosis. It is suggested that the presence of such products, or

toxins, leads to the production of antitoxins within the body, or brings about some subtle chemico-physiological change in the body cells or tissues, which either renders the soil unsuitable for the bacilli or actually leads to their destruction by the cells or body fluids. Koch claimed that his experiments were successful. Marmorek has recently brought forward arguments to show that tuberculin is merely the product of degenerate bacilli grown under laboratory conditions. He holds that this toxin is not the true toxin of the bacilli, and that it is not produced in the human body to any great extent. If this contention is upheld, it is easy to understand why tuberculin has failed Virchow's to establish itself as a specific for tuberculosis. Virchow, objections. moreover, asserted that treatment with this remedy, in the case of human beings, was fraught with danger, as it led to destruction of the tissues around tuberculous centres, and so set free the bacilli and led to further dissemination of the disease within the body. Other observers upheld Virchow's conclusions, and the treatment fell into disrepute. Whether Virchow's conclusions were based on sound evidence or not, this sudden swing of the pendulum was hardly justified, for a large proportion of the harmful effects ascribed to tuberculin were in reality due to the fact that Koch's directions were not properly Heron's carried out and followed. Heron considers that tuberculin views. fell into discredit owing to—

1. Its frequent use in unsuitable cases.
2. Its administration in too large doses.
3. The neglect of the rule that a dose of it should never be given until the patient's temperature has been normal for the previous twenty-four hours.

4. The neglect of the rule that the dose should never be increased, but, on the contrary, should be diminished, when its administration has been followed by a rise of temperature.

Koch, with a view of diminishing the febrile reaction caused by this remedy, has since introduced certain new forms of tuberculin. These are three in number, Modifications of tuberculin. and as they are all loosely included under the term 'tuberculin,' and only differentiated from one another by the letters A, O, and R, it is well to be quite clear as to their mode of preparation and therapeutic action.

Tuberculin A (Tuberculin alkalinum). — This is an obsolete preparation, manufactured by extracting dried tubercle bacilli with decinormal soda and filtering the fluid obtained. Owing to the fact that its injection gives rise to abscesses at the site of inoculation, and for other reasons, it is not employed for diagnostic or curative purposes.

Tuberculin O and Tuberculin R ('Neue Tuberculin-Preparate,' *Deutsche Medizinische Wochenschrift*, 1897, No. 14).—Of these two preparations, the latter, sometimes known by the term 'new' tuberculin, is the only one used in clinical medicine. It is employed solely for curative purposes, and is a thin opalescent liquid, prepared from growths of virulent human tubercle bacilli. The organisms are cultivated on a solid medium, removed, dried in a vacuum, and triturated by machinery in a steel mortar until the individual bacterial cells are reduced to a powder. The powder is then emulsified with sterile distilled water, and centrifugalized. The clear, slightly

opalescent supernatant fluid is removed, and constitutes tuberculin O (*Tuberculin oberer*), or upper tuberculin of Koch. It is probably allied, both in its chemical constitution and toxic action, to the 'old' tuberculin, described on p. 31. It contains the extracellular toxins, and is of no service for clinical purposes. The centrifugalized deposit is dried and pounded; distilled water is added, and the whole recentrifugalized repeatedly until hardly any residue remains. The combined superincumbent solutions (excepting the first, or tuberculin O) are then mixed together, and represent the 'residual' tuberculin, 'new' tuberculin, or tuberculin R (*Tuberculin rückstand*). It is preserved in 20 per cent. glycerine solution, and is standardized to contain exactly 10 milligrammes of solid substance in each c.c. This substance is now used for the treatment of tuberculous patients, and must not be regarded as a substitute for the 'old' tuberculin as a diagnostic agent.

A solution of tuberculin R ('new' tuberculin) may be prepared for clinical purposes in the following manner:

1. Make up a 20 per cent. solution of glycerine by adding 80 c.c. of distilled water to 20 c.c. pure glycerine, and boiling the mixture for twenty minutes. Cool before use.

2. With a sterile pipette, graduated in one-tenths of a c.c., remove from the original bottle 0·3 c.c. tuberculin (tuberculin R), and add 2·7 c.c. glycerine solution. A 10 per cent. dilution is thus obtained, 0·1 c.c. of which, added to 9·9 c.c. glycerine solution, furnishes a 1 per mille dilution. Of this latter, 0·2 c.c. is equivalent to 0·0002 c.c. of the

original fluid. This dilution does not keep beyond fourteen days, and should be freshly prepared. It should be heated for an hour at 60° C., in capsules, so as to kill any living bacilli which may be contained in it.

Other tuberculins have been prepared by modifications of the methods mentioned above, or by employing hydraulic pressure to cultures of tubercle bacilli, or by oxidizing cultures with hydrogen peroxide, so as to convert the toxins into antitoxins. Amongst these may be mentioned the tuberculins of Béraneck, of Hahn and of Denys, of Buet (tuberculo-plasmin), of Hirschfelder (oxy-tuberculin), of Klebs (tuberculoidin and antiphthisin), and of Landmann (tuberculol). The form of tuberculin used for treatment is, however, usually Koch's tuberculin R.

Goetsch, at Koch's suggestion, has reported his experience with various forms of tuberculin in 175 cases of pulmonary tuberculosis treated during the last ten years. This observer regarded no case as one of tuberculosis unless tubercle bacilli were found, or there was an unmistakable reaction to tuberculin; and he considered no patient to be cured unless the bacilli disappeared, and until a large dose of the old tuberculin was tolerated without reaction. His results have been remarkable, for out of the 175 cases 125 (or 71 per cent.) have been cured, whilst 50 improved. We must remember, however, that his cases were carefully selected ones in which the disease was not far advanced, and where, presumably, there was no secondary infection. Further, his cases were all treated on hygienic principles, with an abundance of pure air and good food.

Goetsch's experience.

Goetsch gives the injections twice a week according to the following rules:

1. The treatment should only be adopted when the patient is free from fever.

2. The amount injected should not be increased until the last dose is tolerated without reaction.

3. The patient, on the day of the injection as well as on the day following, must remain in bed.

The initial dose given by Goetsch was usually 0·001 gramme of the old tuberculin. If any fever resulted, the dose was reduced to 0·0001 gramme; if this was not tolerated, then tuberculin R was given, commencing with the dose of 0·001 milligramme. This was gradually increased until 0·1 milligramme was reached, when from 0·0001 to 0·001 gramme of the old tuberculin was injected. If the latter was well borne, the dose was gradually increased to 1·0 gramme.

Pottinger, in a 'Critical Study of Tuberculin and Allied Products, based upon a Collective Investigation,' has brought together in convenient form a number of views and statistics on the value of tuberculin as a curative agent. This pamphlet embraces 5,742 cases. Trudeau, investigating 50 cases treated by hygienic methods and by this remedy, and 50 cases treated only on hygienic lines, found that there was a balance of 16 per cent. in favour of cases treated by this remedy; that is to say, 16 per cent. more cases remained apparently cured. Pottinger, in his summary of conclusions, writes: 'Basing an opinion on

the results in 1,200 first-stage cases, 611 of which were treated in sanatoria by the usual hygienic and dietetic methods, and 589 by the same careful management plus tuberculin and allied products, we find that, of those treated in the latter manner, 20·2 per cent. more were cured than where the tuberculin preparations were omitted from treatment.' This author goes on to say that when tuberculin is used there is also much less danger of a relapse.

There is considerable prejudice against the use of what is known as Koch's new tuberculin for the purpose of treatment, but this prejudice is due to this vaccine having been given in unsuitable cases and in much too large doses. Clinical experience has shown that minute doses of tuberculin, carefully given by an experienced observer, are of great service in the treatment of surgical forms of tuberculosis—that is, in 'closed' tubercle, or in cases where there is no systemic infection. In pulmonary tuberculosis without systemic infection—that is, in cases where the tuberculous lesion is very early, or is of older date, but largely cut off by fibrous tissue—minute doses of tuberculin, together with open-air treatment, would appear to give a larger proportion of arrest of the disease, and to make the arrest more permanent than treatment by open-air methods alone. The use of tuberculin in systemic infection, or in rapidly-advancing disease, is useless and frequently harmful.

Method of administering Tuberculin R.—Each dose should be given subcutaneously with strict aseptic precautions. An injection should cause no rise of temperature and no appreciable local reaction. If an injection does cause

Dose of tuberculin R.

fever or reaction, it is too large and may do harm, and subsequently smaller doses must be employed. The chief difficulty in this form of treatment is to determine the dose of the vaccine which should be employed in an individual case. The amount of each dose must be determined by the general condition of the patient, and smaller doses should be given to children and weak adults than to adults whose general condition appears satisfactory. Too large a dose in any case may do harm; therefore it is wise to err on the side of too small a dose until a particular patient's reaction to tuberculin is learnt by experience. *The dose is always measured and expressed in fractions of a milligramme of solid substance* (see p. 172). At one time $\frac{1}{500}$ milligramme was given as the initial dose, but experience has shown this to be too large. In the majority of cases this dose should probably not be greater than $\frac{1}{2000}$ milligramme; and if the patient is in a debilitated condition the initial dose should not be greater than $\frac{1}{5000}$ to $\frac{1}{2500}$ milligramme. If the initial dose causes any disturbance, the next dose must be smaller. Subsequent doses should, as a rule, be given about every ten or fourteen days. Each case must be treated on its merits, and care should be taken to avoid giving a dose of tuberculin when the patient shows any symptoms of an aggravation of the disease. For example, a dose should be withheld if there are signs of any extension of the disease, if there is any increase of fever, or if there is general malaise. In fact, if the clinical evidence shows that more toxin is being poured out by the bacilli than the resistance powers of the patient can meet, the treatment with tuberculin should be omitted until a more suitable occasion

presents itself. If the general condition of the patient is satisfactory, a dose of tuberculin may, as I have said, be given about once a fortnight. The dose may be very gradually increased, but should never exceed $\frac{1}{20}$ milligramme. The course of treatment should not, as a rule, extend, if no improvement results, over more than three months, and in all cases should be combined with open-air treatment. If improvement take place, the treatment with the vaccine may be continued even for some months after the disease is apparently cured.

In this country of late it has been the custom to 'check' the use of tuberculin by means of the opsonic index. The opsonic index in the The meaning and value of the opsonic index are discussed tuberculin treatment. on p. 26. I have already stated that, in my opinion, our knowledge of the meaning of opsonins is not sufficient as yet to warrant any very definite deductions of its value, and that the technique is faulty and open to error. This is true not only of the use of the opsonic index for diagnosis, but also in the treatment of tuberculosis. The objections mentioned on p. 30 with regard to the use of the opsonic index for diagnostic purposes hold good with regard to its use for treatment, and one or two more may be added.

It is allowed that for diagnostic purposes the possible errors of the method are so considerable that four or five observations must be made before a conclusion is formulated, but for purposes of treatment we are told that one observation of the index is sufficient to indicate the advisability or the reverse of injecting a vaccine.

It is held by those who believe in the efficacy of the opsonic index that its value in treatment by means of a

vaccine such as tuberculin depends on the fact that it shows the presence of the negative and positive phases of the opsonic content of the blood—that is, of the amount of protective substances or antitropines. It is further held that when these contents are in a marked negative phase no vaccine should be given, as it will do harm and accentuate the effect of the toxin which is being poured out by the bacilli, and which has caused the negative phase. In other words, tuberculin should only be given to a consumptive when the opsonic index shows that a positive phase is beginning to wane.

Now, it usually happens that the opsonic index is determined and the result given to the clinician some hours, or it may be a day or days, after the blood is withdrawn from the patient. A positive phase may last only an hour or two hours, and an injection given some hours after a positive phase has been present may be given when a negative phase has become well established, and therefore do harm rather than good. If the reasoning of those who advise the use of the opsonic index is sound, the opsonic index should be determined as soon as the blood is withdrawn from the patient, and immediately it is known to be suitable an injection should be given. This in the majority of cases is impossible, and even at the best the determination of the index takes two hours. Another objection to advising a method which rests on an insecure foundation is the fact that the determination of a series of opsonic indices is an expensive matter. The use of the opsonic index to regulate the dose of vaccine in diseases other than tuberculosis has been stated by a number of authors to have led to good results. The

majority of these cases, however, have been published before sufficient time had elapsed after the cessation of treatment to be sure that there had been none of the relapses which so commonly occur in cases which are stated to have been cured by new methods of treatment.

If the opsonic index is used to control the injections of tuberculin, it is stated that after an injection there is a negative phase, which lasts three or four days, but which may last two weeks or more. The larger the dose, the more prolonged is the negative phase; with a very large dose the positive phase may be completely absent. The dose of vaccine is regulated by the variations of the negative phase. A prolonged negative phase points to the dose being too large; again, if successive negative phases are longer, the dose is too large. If successive negative phases are shorter, the dose is either correct or too small; if it is too small, the positive phases will not be well marked, and the clinical progress will not be satisfactory.

The main points in the treatment with tuberculin are to use very minute doses, and to vary them in accordance with the clinical evidence. Quite as good results have been obtained, if not better ones, by the use of tuberculin on these lines, even in surgical tuberculosis, as have been obtained by the use of tuberculin when regulated by the opsonic index.

Antiseptics are employed by many physicians of experi- Antiseptics. ence, and good results are claimed for them; none of them, however, can be regarded in any way as specifics. Remedies of this character are employed either with the idea of acting directly upon the tubercle bacilli and so destroying them, or diminishing their virulence, of in-

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fluencing the action of those micro-organisms which are commonly associated with the tubercle bacilli, or of acting upon the tissues and facilitating the formation of anti-toxins. It is known that many substances will destroy tubercle bacilli in test-tube experiments, but the difficulty of using these in the treatment of disease is that, if given in sufficient strength to destroy the micro-organisms, they have a still more powerful effect upon the living tissue-cells. Consequently, until we find some substance which is innocuous to the tissue cells, but which will, nevertheless, prevent tubercle bacilli from growing, we must look in vain for any striking success from this class of remedy.

Methods of adminis- trations

Such antiseptic agents may be given by the mouth or by subcutaneous or intravenous injection, or they may be given as inhalations or intra-laryngeal sprays, or may even be directly injected into the lungs. It is possible that inhalations may prevent infection of the larynx, and may exert some influence upon the associated micro-organisms, but personally I have seen little benefit result from their use. Intra-laryngeal injections may be attended with serious results; I have seen two cases of gangrene of the lung follow this method of treatment in the hands of others, when olive-oil was employed as the vehicle. Injec- tions of iodine, iodoform, carbolic acid, creosote, or other substances, directly into the diseased portion of the lungs, as advocated by Pepper, by means of a long hypodermic needle, may, according to Osler, be practised, as a rule, with impunity, but the results are disappointing.

Formic aldehyde.

Formic aldehyde is nowadays said to be the most powerful antiseptic for tubercle bacilli, and it is stated, amongst other things, that it is non-poisonous and non-

corrosive. On the other hand, its effects on many people are intensely irritating. It may be given as an inhalation, or by intravenous injection.

(*a*) *Inhalation.*—Muthu advocates the use of the drug in two forms: (1) as a gas, (2) as a 40 per cent. solution—*i.e.*, the commercial formalin. The gas is generated either by placing formalin tabloids on a metal tray over a methylated-spirit lamp, or by using, in addition to the above, a boiler for generating steam, so that the latter may mix with the formaldehyde vapour, and render it more diffusible. The second method, according to Muthu, gives the better results. The vapour is administered to the patient in a room in which the doors and windows are closed. The lamp is then lighted, and the boiler filled with hot water, and the tablets placed inside. The patient then sits in a lounge chair or lies in bed, and inhales the gas for one, two, or three hours. At first the vapour causes irritation of the eyes and nostrils, but it is stated that tolerance is quickly established. *By inhalation.*

When, instead of the gaseous form, the aqueous solution known as formalin is used, it is either placed in an inhaler which the patient holds in his mouth for from four to six hours in the course of the day, or it is employed as a fine spray or in a nebulizer, a 6 to 10 per cent. solution being mixed with glycerine.

Muthu has obtained good results from this drug, but always in conjunction with open-air methods, and has come to the conclusion that it— *Muthu's conclusions.*

1. Soothes the laryngeal and bronchial mucous membrane.

2. Renders the expectoration less tenacious, and in time diminishes it.

3. Lessens the fever.

4. Diminishes the number of tubercle bacilli, and in some cases entirely eradicates them.

(b) *Intravenous Injection.*—Maguire tried the effect of a number of substances when injected into the veins, but discarded them all in favour of formic aldehyde, as this agent did not cause fever, and was safer in other ways. He argues that anything injected into the veins must go directly through the lungs by way of the right heart, and in this manner 'wash these organs out.' He finds that it

is best to use a solution of formic aldehyde gas in normal saline (0·6 per cent. sodium chloride), in a strength of 1 part of gas to 2,000 of normal saline, and to the extent of 50 c.c. daily. A larger quantity or a stronger solution should be avoided, as albuminuria, hæmaturia, and thrombosis of veins may result. Strict antiseptic precautions should be taken in the preparation of the solution, and with regard to the preparation of the skin in the neighbourhood of the vein selected for the injection. The median vein is the usual one selected for the purpose, and the process resembles that followed in transfusion. A needle of large calibre should be employed, and should be plunged boldly into the vein, care being taken not to wound the posterior wall. Maguire, in his original experiments, found that he could inject, by means of a special form of apparatus, 2 c.c. of the 1 in 2,000 solution during the space of five heart-beats. This means that for five heart-beats 0·4 c.c. of the solution pass from the heart to the lungs, or, in other words, these organs are 'washed out' during this time with a 1 in 500,000 solution of formaldehyde. Maguire has more recently been able to

increase the strength of the solution when passing through the lungs to 1 in 50,000, and to prolong the times during which the injections are made.

It is said that when patients are treated in this way there is an improvement in the physical signs of the disease, as well as a diminution in the amount of expectoration, a decrease of fever, and in some instances a decrease in the number of tubercle bacilli, or the actual disappearance of these micro-organisms from the sputum. Other observers assert that there is no decrease in the number of tubercle bacilli, but that the number of streptococci and similar organisms is diminished.

At first sight it is a little difficult to understand how treatment by intravenous injections of antiseptics can be of any service in a disease which is cut off from the blood-stream, and is to all intents and purposes, so far as its active manifestations are concerned, extra-vascular; but against this we have the practical experience of accomplished physicians, who maintain that the treatment is of great service when combined with ordinary methods. I can only say that my experience has been less fortunate; in some instances I have seen injurious effects, such as hæmoptysis, follow; in others I have seen no improvement, and in a few, in which improvement took place, I was not able to satisfy myself that it was due to formaldehyde, or that it was greater than what is ordinarily obtained by other means.

Dewar has brought forward a few results of cases treated by injections of iodoform. These injections were given by methods similar to those employed by Maguire. The number of cases so treated is not yet sufficiently large

Conclusions

Iodoform.

to permit of any reliable deduction being drawn as to the value of the treatment.

Creosote.

Creosote and its various preparations have been lauded as specifics, but the claims put forward have not stood the test of experience. It has, however, been recently asserted that creosote induces changes in the blood, which lead to the agglutination of tubercle bacilli outside the body. The drug, and especially its derivatives, guaiacol carbonate and creosotal, have been shown to be valuable when given in moderate doses, on account of the effects produced, more especially upon the digestive organs, and so upon the general nutrition. Moderate doses (1 minim) three or four times daily, according to Binz, increase the peristaltic action of the stomach. When combined with alcohol this action appears to be increased to the extent of 120 per cent. Creosote and its derivatives also undoubtedly lessen the cough and the amount of expectoration. Their action upon suppuration and in preventing decomposition of the contents of the bronchi or cavities is unquestionable. I find that beech-wood creosote gives more satisfactory results than the other forms of this drug. Care must be taken that the preparation used does not contain carbolic acid, a not uncommon impurity, as this acid leads to aggravation of the cough and to gastric disturbance. The dose at first should be small ($\frac{1}{2}$ minim to 1 minim), and should then be cautiously increased. The drug should never be given on an empty stomach, and should be administered in the form of capsules. Its use should be continued over a long period of time.

Dose.

Friar's balsam.

Friar's balsam was probably used by former generations

more frequently than any other remedy. Hofmann says:
'I have seen persons labouring under perfectly formed
phthisis and seriously affected for several years happily
restored by the use of this very balsam.' One of the chief
constituents is benzoic acid; another is cinnamic acid.
Benzoic acid, when taken by the mouth, is excreted as
hippuric acid, and this latter acid is found in the urine of
cattle. It has been suggested by Dr. P. W. Latham that
the virulence of human tubercle bacilli may be attenuated
by benzoic or hippuric acid, and that the presence of the
latter acid in the blood of cattle may explain why tubercle
bacilli from human sources are unable, in many instances,
to produce tuberculosis in these animals. Be that as it
may, there can be no doubt that the drug, so much in use
in former days, is of service in many cases now, although
it is not a specific. It certainly seems to have a beneficial
effect upon the general nutrition, and to allay irritative
forms of cough. I have prescribed it for patients who,
for various reasons, were unable to conform with the
hygienic methods of treatment, and have obtained good
results in some instances.

A man with early infiltration of the right apex attended Case.
the Brompton Hospital. He was unable to live under
ideal conditions, and so was given general directions and
treated with balsam of Peru. In three months he had
gained 2 stone, and the bacilli had disappeared from his
sputum. His improvement was in every way greater than
that of other patients treated at the same time by different
methods under similar conditions.

The following prescriptions are of service in this connec- Prescrip-
tion: tions.

R.   Sodii benzoatis   ...   .   gr. xv.
     Syrupi aurantii   ...   .   ʒi.
     Aquam ...   .   ad ʒi.
Sig. : To be taken twice or three times a day two hours after food.

R.   Tincturæ benzoini compositæ   ...   ʒss.
     Pulveris acaciæ   ...   .   ʒss.
     Aquæ cinnamomi   ...   .   ʒi.
     Aquam ...   .   ad ʒvi.
Sig. : A fourth part twice or three times a day two hours after food.

R.   Balsami peruviani   ...   .   ʒii.
     Ovi unius vitellum.
          Tere simul et adde :
     Aquæ cinnamomi   ...   .   ʒvi.
     Tincturæ aloes...   ...   .   ʒiii.
     Syrupi mori   ...   .   ʒii.
Sig . : A sixth part to be taken twice a day after food.

(DR. J. A. PARIS.)

Potassium cantharidate.   Some years ago Liebreich introduced the use of potassium cantharidate as a treatment for lupus and tuberculous disease of the larynx and lungs. This author injected under the skin 8 to 16 minims of a 1 in 5,000 carefully sterilized solution of the salt, his idea being that it caused a local irritation at the tuberculous focus (in the same way as setons, which were so commonly employed at one time), and that the consequent increase of blood and serum would tend to the destruction of the tubercle bacilli, and to the strengthening of the resistance of the surrounding tissues. Liebreich's theory has not been substantiated, although a certain number of good results have been attributed to this method of treatment. The action of the drug must be carefully watched ; it should not be given in cases complicated by renal disease, as it may lead to much irritation of the kidneys, and set up hæmaturia.

Urea.   It is known that acute tuberculosis is not often asso-

ciated with gout, although cases of chronic tuberculosis in gouty persons are far from uncommon. Sir Dyce Duckworth recognises an antagonistic influence of the gouty upon the tuberculous habit, and Sir Hermann Weber regards an attack of gout in a consumptive patient as a most favourable complication. Harper has consequently Harper's come to the conclusion that 'nitrogen and nitrogenous products are the remedies *par excellence* for the tubercle bacillus.' He regards urea as the most suitable means of increasing the amount of the nitrogenous intake, and he asserts that ' urea exerts a specific action on tuberculosis quite as marked as mercury on a syphilitic node.' This epigrammatic statement is, however, somewhat modified by the author when he says urea is only of value in this disease when Koch's bacillus is the predominating bacillus, and that cases with much secondary infection are unsuitable for its administration. The administration of urea does not materially increase the nitrogenous output, and possibly, therefore, it saves unnecessary nitrogenous waste in somewhat the same way as was suggested by the supporters of the old physiological theory of luxus consumption. The drug should be given in doses of 10 to 15 grains at first. The dose may then be gradually increased to 40, 50, or even 60 grains thrice daily. Beefsteak and port wine probably supply the necessary nitrogenous material in a better and more palatable form ; and some authorities assert that raw-meat juice or raw meat affords the best means at our disposal for increasing the nitrogenous intake.

My own experience of urea is not such as to convince Author's me of its merits. The improvement which has taken experience.

place in patients who were under hygienic conditions, was certainly not greater after a prolonged trial of urea than the improvement in other (control) patients who were under precisely similar hygienic conditions. Further, some patients are unable to take the drug, as it occasionally induces an irritative dyspepsia, although this drawback may usually be avoided by giving the urea in a large quantity of water. Vere Pearson has analyzed the results obtained by the use of this drug, and has formed conclusions almost identical with those just stated.

Saturation of the body with acids.   Somewhat similar reasoning to that of Harper has led Berheim to endeavour to transform the 'soil' of the tuberculous individual to a hyperacid soil which is antagonistic to Koch's bacillus. Consumptive patients are deficient in chlorides, phosphates, and especially acids ; arthritics are rich in chlorides and superabundant in acidity. Tuberculosis is rare in arthritic persons, and of benign manifestation in them. Further, as tuberculous patients improve there is a marked increase in the urinary acidity ; therefore we should, Berheim argues, endeavour to convert the 'tuberculous soil into an arthritic soil.' This author prefers early cases,· and treats them by a hygienic and dietetic regimen, and by saturating the general system with a 'powerful acid such as phosphate of creosote or phosphoric acid.' He claims to have proved that, under the influence of phosphate of creosote taken in doses of 3 grammes every two days, the acidity rapidly increases, and the general and local conditions improve.

Serum.   Maragliano claims good results from different forms of serum, obtained from dogs, asses, and horses, which have been injected with highly toxic bodies extracted from

living bacilli, but his experience has not been confirmed by others. Trudeau and Baldwin have submitted a large number of antitoxins to a variety of tests over a period of several years, and they have not been able to demonstrate that any of them possess either a germicidal or a curative effect.

Of late years several new serums have been on trial. Marmorek's serum. Of these the most important is the serum made by Marmorek. This investigator came to the conclusion that tuberculin was not the true toxin of the tubercle bacillus, but rather the degenerate product of old bacilli under laboratory conditions. He found after a series of laboratory experiments that he was able to develop a race of bacilli which secreted no tuberculin when young. These bacilli, kept on a particular medium, developed a toxin which killed animals, and which Marmorek regards as the true toxin of the tubercle bacilli as secreted in the human body. Proceeding on the lines followed in obtaining antidiphtheritic serum, Marmorek was able to immunize horses against tuberculosis, and so to obtain an antituberculosis serum and vaccine.

A number of good results from the use of Marmorek's serum have been recorded. In estimating the value of this method of treatment, as in any other form of treatment for tuberculosis, there are peculiar difficulties. In the first place, we have the fact that many cases of tuberculosis are arrested without any special form of treatment, and there is always the doubt present that cases which have improved under a particular form of treatment would have done as well if left alone. It is impossible to have any control against this source of error, except

the accumulation of experience in a large number of cases. In the second place, in any new form of treatment the dose and technique have to be determined, and it sometimes happens that a treatment condemned in the first instance is of value when the proper dose and technique is ascertained.

In a large proportion of my own cases the patients expressed a definite opinion that they felt better for the treatment ; in some no good result at all was obtained ; in others the physical signs, temperature and general condition all improved. In none of my cases, however, can I say without hesitation that the serum has acted as a ' specific ' for the disease.

It is, however, already obvious that in cases in which extensive infiltration is present no benefit is derived from Marmorek's serum. It is probable that it has not much effect in cases of more than two years' standing, or in which the patient is more than thirty-five years of age. Many individuals cannot support the serum any more than they can support antistreptococcic or other serums. In such cases serum rashes, rise of temperature, enlargement of glands, distressing flushings, and similar symptoms, make their appearance. In all instances where such symptoms occur the use of the serum should be intermitted, and tentatively renewed after the lapse of a week or more. In all cases, again, it is advisable not to push the serum unduly, but to allow sufficient intervals between the injections, as it would seem probable that too large doses or injections continued for too long a period of time, without sufficient intervals between such series, tend to lower the resistance of the body. It

is possible that the serum in these larger quantities may inhibit the natural formation of the antitoxin by the body cells; but whether this be so or not, there can, I think, be no doubt that great care must be exercised in the use of this remedy.

In acute cases, doses of 10 c.c. a day may be given for ten days if no harmful result is apparent, such as persistent rise of temperature. In chronic cases doses of 2·5 c.c. night and morning may be injected with the usual aseptic precautions into the arm, back, or abdomen. It is immaterial whether the injections are made subcutaneously or into the muscles. The daily doses of 2·5 c.c. may be continued for four days. Four days' rest should then be given. A further series of injections for four days is advised by Marmorek, to be followed by a further period of four days without injections. Another series of injections of the same dose may then be given for four days; after this there should be freedom from injections for three weeks or a month. After the lapse of this time the injections may be repeated on exactly similar lines.

Recently good results have been obtained by the following method: The serum is given by rectal injection, after the rectum has been well emptied, in doses of 5 c.c. to 10 c.c. These doses—preferably 5 c.c.—are given daily for three weeks, provided no rise of temperature or malaise results. A week's interval is then allowed, and then a further series of injections given. The treatment on these lines may be continued for several months, but, as a rule, the intervals of freedom from injection should be longer than a week if the course of treatment is at all prolonged. If the case is an afebrile one there is no need to confine

the patient to bed. Each case must be treated on its merits, the chief points being that the serum should not be unduly pressed, and that whenever any deleterious symptom due to the serum (rather than to the antitoxin it contains) arises, the injections should be omitted for a time.

Tonics.   Of the remedies known as tonics, it may be said that they are frequently useful, but are not specifics.   Cod-liver oil is of service in that it is a food and aids nutrition. The various preparations of arsenic and iron stimulate metabolism, and are extremely useful tonics in the more chronic forms of consumption.   Hypophosphites also act as tonics.   The use of this class of remedy is discussed more fully in connection with the treatment of special symptoms.

CHAPTER VIII

THE TREATMENT OF SPECIAL SYMPTOMS

ENOUGH has been said in the previous pages to show that the hygienic or sanatorium method of treatment is the best at our disposal for both the chronic and acute stages of the disease, and that we have to rely on fresh air, good food, and the avoidance of debilitating influences, rather than on medicinal remedies. This is true not only of the treatment of the disease itself, but of the individual symptoms. No drug has anything like the effect on the cough, night-sweats, fever, or loss of weight, that sanatorium treatment has, and consequently whenever it is possible to adopt this method, even in an incomplete form, we should have recourse to it. Unfortunately, however, it often happens that our patients—from one cause or another, such as their occupation or financial position—cannot live under these ideal conditions even for short periods of time. In such cases, and also in cases of advanced disease, we may be forced to give medicinal remedies; but in every instance we should endeavour to arrange that the ideal conditions are followed as closely as the individual circumstances permit, and we should never give drugs without a definite purpose, and never without

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considering whether in treating the symptom we are not aggravating the disease.

DEBILITY.

Frequently the earliest symptom of consumption is a feeling of languor or fatigue. This is not unusually associated with a progressive loss of weight and more or less marked anæmia. Almost all tonic remedies are of service in this condition, more especially cod-liver oil, arsenic, alone or in conjunction with quinine, the various preparations of iron, and the hypophosphites of lime and soda.

Cod-liver oil.　Cod-liver oil is certainly beneficial in improving the nutrition ; it acts as a food, and may in suitable cases be replaced by cream, butter, or fat. It should be given in as palatable a guise as possible. It may be prescribed in the form of an emulsion, its flavour being disguised with orange-juice, coffee, cognac, liquid extract of liquorice, and other substances. The use of sweet syrups for this purpose should be avoided, as they tend to impair digestion. The following is a useful combination :

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℞.  Olei morrhuæ      ...     ...     ...     ... ʒviii.
     Vitellos ovorum duorum.
     Pulveris tragacanthæ     ...     ...     ... gr. xvi.
     Tincturæ benzoini compositæ   ...     ... ʒi.
     Spiritus chloroformi    ...     ...     ... ʒiv.
     Olei amygdalæ essentialis     ...     ... ♏viii.
     Aquam     ...     ...     ...     ...     ... ad ℥viii.
  M.  Sig. : One to four teaspoonfuls to be taken after food.
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The flavouring agent may be varied to suit the individual taste. Many patients prefer the oil without any addition. Sometimes patients who are unable to retain the oil when taken immediately after food can do so by

taking half a teaspoonful the last thing at night when they are in the recumbent position in bed, and gradually increasing the dose. The remedy may also be given in capsules, or in the form of a pancreatic emulsion. Petroleum may be useful occasionally as an alternative. Cod-liver oil should be given in small doses, not more than one or two teaspoonfuls two or three times a day after food. It may be given in combination with malt ; thus we may prescribe two teaspoonfuls of Kepler's extract twice or three times a day. Cod-liver oil should not be prescribed when much febrile or gastric disturbance is present, or if it distresses the patient ; nor should it be given during warm weather if it is not easily borne. It is advisable to inspect the stools occasionally when the oil is taken, to see that it is satisfactorily absorbed. Good results have been observed, more especially in children, when the oil has been well rubbed into the body at night-time ; part of this good effect is no doubt due to the stimulating effect of the massage.

Arsenic is often of service in the treatment of chronic Arsenic. pulmonary tuberculosis. Some physicians regard it as a specific, but in the opinion of others it acts solely by stimulating the nutrition. Three to five minims of the liquor arsenicalis may be given twice or three times a day in two tablespoonfuls of water after food. This remedy may also be prescribed in conjunction with quinine, 1 grain of the latter drug being given in the form of a tabloid with a wineglassful of water half an hour before the mid-day and evening meals. The arsenic should be continued for three or four weeks, and its use then suspended for a time ; it should be discontinued if its use leads to gastric or other

disturbances.   Other forms of the drug which are of service are arseniate of soda, in doses of $\frac{1}{20}$ grain in a tablespoonful of water twice or three times a day, and sodium cacodylate in doses of $\frac{1}{2}$ grain by the mouth, or $\frac{1}{4}$ grain by hypodermic injection.   The latter combination is often tolerated when other preparations lead to disturbance, and it is free from unpleasant effects, such as the taste of garlic, which some patients experience with other

Iron.

forms of the drug.   *Iron* may be given in the form of the syrup of the iodide or phosphate in drachm doses twice a day, or in conjunction with arsenic. Blaud's pills may also be prescribed.   Iron should not be given to patients in whom there is a tendency to gastric catarrh or constipation, nor should it be given when there is hæmoptysis or much cough, as it is said to increase the tendency to hæmorrhage. It certainly aids the nutrition, but does not appear to have quite the same effect in the anæmia of tuberculosis as it has in chlorosis and certain other forms

Hypophos-
phites.

of anæmia.   *The alkaline hypophosphites* act as tonics, and in some cases appear to increase the tendency towards the formation of fibrous tissue.   They may be given in 1 to 5 grain doses twice a day, and may be usefully combined with other tonics.

FEVER.

We have already seen that in the treatment of this symptom the chief essentials are absolute rest within certain limits, pure air, and an abundance of solid food.

Solid food the
best remedy.

The more solid food the patient can take, the sooner will his temperature decline. If these measures fail, the patient may be sponged two or three times a day with

tepid water, to which some eau de Cologne or toilet vinegar has been added. This not infrequently lowers the temperature, and always has a refreshing effect. Antipyretics, such as antifebrin, phenacetin, quinine, and sodium salicylate, should be avoided, as their use leads to depression, and in any case the effect they produce is merely a temporary one. At the Berlin Congress, Kobert stated that the antipyretic chiefly used for this purpose by German physicians was pyramidon, owing to the fact that it was less depressing, and produced a more lasting effect than other remedies of this class. The dose of pyramidon is from 5 to 30 grains. It may be given every three or four hours, provided that not more than 40 grains are taken in the twenty-four hours. It is usually prescribed in capsules or in an aromatic solution.

COUGH.

To the lay mind the main characteristic of pulmonary consumption is the cough, and it is possibly in consequence of this that phthisical patients are exposed to such indiscriminate drug treatment for the relief of this symptom. A cough in a consumptive patient is apt to be treated with a large variety of drugs without any very careful investigation being made as to its cause. The real cause of the cough may be the condition of the throat, but it not infrequently happens that this is overlooked, and that the patient is treated on routine principles with an expectorant mixture. We should always make a careful search for the cause which gives rise to this distressing symptom, and avoid the routine practice of assuming that it results from irritation of the lungs. The practice of treating the cough

of a consumptive person without any definite knowledge of the cause of this symptom is, to my mind, most pernicious, and one which does incalculable harm. As Sir William Whitla has said, 'There can scarcely be instanced a greater mistake in medical practice than the routine treatment of pulmonary consumption by cough mixtures. The use of the various expectorants and anodynes, which unfortunately constitute the chief portion of the antiphthisical armamentarium of some physicians, only leads to destruction of appetite, disordered digestion, increase of sweating, and all the numerous ills resulting from retained secretion.' In a large number of cases of pulmonary tuberculosis the cough, although to some extent dependent upon the diseased condition, arises from other contributory causes which are well within our power of prevention. I may cite, as an example of this, the cough which sometimes ensues when a patient gets into a bed, the sheets of which are cold. Such cases are obviously not benefited by liberal doses of expectorant mixtures. In

Must determine the cause of this symptom.

another large group the cough is due to accidental causes, which have comparatively little to do with the original disease—causes such as a smoker's throat and chronic granular pharyngitis. In other instances, however, especially when the disease is more advanced, the cough is directly dependent upon it. In these it is often useful, and may, in selected instances, be encouraged; but we must remember that even here the cough may arise from a variety of causes, in the treatment of which drugs are of little avail. For instance, I saw recently a young girl in the last stages of tuberculosis, who was almost entirely prevented from sleeping by the frequency of her cough.

She had been dosed with anodynes, but the only effect of these was to upset her digestion completely. Her cough was due to pleuritic inflammation, and practically subsided when her chest was securely strapped.

The causes of the cough which occurs in the course of General causes. pulmonary consumption may, I think, be grouped under the following headings : (1) Reflex irritation, especially from sources other than the air-passages, without any need for expectoration ; (2) the necessity for removing accumulated secretion ; (3) causes other than, though often dependent upon, the original disease. My meaning will be made clearer if I give a few examples.

All forms of cough are, properly speaking, reflex in Examples of causes. origin, but as causes of (1) reflex irritation—in the somewhat restricted sense I am adopting—I may mention exposure to sudden differences of temperature, such as going from a hot sitting-room to a cold bedroom ; exposure to wind or dust ; exertion, such as rapid walking, talking, and the like. If a patient walks quickly, not only does he run the risk of being overheated, but he is very liable to bring on an attack of coughing. This form of cough may also arise from pleuritic irritation or dryness of the throat, the latter brought on, perhaps, by the exhibition of belladonna for night-sweats. Again, we not infrequently meet with individuals in whom a distressing cough comes on after taking food, and ends in vomiting. This may be due to various conditions of the stomach, which set up reflex cough by exciting the endings of the vagus nerve, or, on the other hand, it may be due to tenacious mucus tickling the fauces. As examples of (2) the necessity of removing accumulated secretion, I may

cite the morning cough of consumption, which is due to
the accumulation of the expectoration during the night,
or the cough in advanced cases which is brought on by
the accumulation of secretion in tuberculous cavities, or
by a sudden change of position. Among (3) causes other
than, though often dependent upon, the original disease,
may be mentioned chronic catarrh of the pharynx, which,
in my experience, is the main cause of cough in a sur-
prisingly large number of individuals who live in large
towns. Other examples are tracheitis, laryngitis—whether
tuberculous or not—and intercurrent attacks of bronchitis.

There can be no doubt, then, that the cough which
occurs in tuberculous persons is not likely in all cases to
be remedied or relieved by means of expectorant mixtures,
and that its routine treatment by means of anodynes is
not based on sound reasoning. In other words, our first
consideration in treating a cough in a tuberculous patient
must be to determine, with an unbiassed mind, the patho-
logical condition which excites it.

In a number of instances tuberculous patients have
no cough—that is to say, it is not absolutely necessary
that a patient suffering from pulmonary tuberculosis
should have a cough. In some cases the cough is almost
entirely the outcome of habit, and can be largely relieved
by the exercise of a little self-restraint. In many others it
is due to the patient's surroundings and to want of care in
avoiding the causes which give rise to it. Nothing is
more certain than that such a cough often ceases without
any drug treatment if the patient is placed under suitable
Open air the conditions. When I had the good fortune to spend a few
best remedy. weeks at Dr. Walther's sanatorium in the Nordrach

Colonie, I was much interested by the fact that during the time I was there I hardly ever heard one of the sixty odd patients cough during the daytime. Patients in whom the disease was advanced occasionally had to get rid of expectoration, but this was done without any cough in the ordinary sense of the term. Many individuals who go to a sanatorium with a cough lose this symptom in a few weeks. Anyone who is familiar with *effective* open-air treatment must have noticed this striking result. To my mind, it is a very marked object-lesson of the truth that, in the treatment of consumption, the best way to cure the symptoms is to improve the general condition and surroundings of the patient. Therefore I maintain that, to alleviate a cough which is in any way dependent upon pulmonary tuberculosis, we must first place our patient as far as possible under the ideal conditions for the treatment of the original disease, which have already been discussed. If we treat the symptom without regard for the disease, we soon find that, though the symptom may improve, the disease is aggravated.

When patients cannot conform to the ideal conditions, we may be obliged to try the effect of certain drugs or other remedies. We must, naturally, first determine the cause of the cough, and as far as possible adopt such measures as may remove it. If the cough is due to some definite pathological change, we should, before prescribing, always consider whether our medicines will in any way interfere with the digestion, for a consumptive patient whose powers of assimilation are lessened cannot fail to deteriorate in health. It occasionally happens that the relief of the cough is so pressing that we must take the

Open-air treatment not always possible.

risk of any possible harm resulting from a disordered
digestion. For instance, a patient may be steadily losing
ground from want of sleep, brought on by a distressing
night cough. In such cases we may have to use opium,
but we must not forget that we are buying sleep at a price.
We should exhaust all measures at our command before
using such drugs as opium, chloral, henbane, or bromides.
We should be careful, also, in prescribing syrups and the
like. If we decide to treat the cough with drugs, we must
further decide whether we ought to encourage, or try to
diminish, the expectoration.

Examples of medicinal treatment.   After having said so much upon the principles which
I think we should follow, I may, perhaps, give a few
examples of the treatment of certain forms of cough by
Morning cough. medicinal means. The cough which occurs the first thing
in the morning, and is accompanied by expectoration,
is useful, and must never be checked by a sedative. We
can aid this form of cough by giving some warm drink,
such as milk or tea, to the patient before he rises. Or we
may give a little rum and milk—a dessertspoonful of rum
to a claret-glass of warm milk—or we may prescribe some
alkaline draught. If this morning cough is accompanied
by vomiting, as not infrequently happens, we should
determine whether this symptom is due to the condition
of the stomach, or whether it is brought on by reflex
irritation of the fauces (arising from thick mucus and the
like), and prescribe appropriate remedies (*vide infra*). In
such cases it is important that the patient, in spite of
the vomiting, should take a satisfactory breakfast. When
Dry cough. we have to deal with the dry, hacking cough, which is so
common in tuberculosis, we should first make certain that

the upper air-passages—which, in my opinion, play such
an important rôle in the etiology of consumption—are
free from suspicion.   If we find some form of inflamma-
tion in this situation, we must treat it.   I am not in favour
of inhalations, at any rate of those which involve the use
of hot fluids, nor have I much faith in respirators charged
with oil of eucalyptus and other preparations.   Respir-
ators, however, are most useful in preventing certain forms
of cough—when, for instance, it arises from the inhala-
tion of fine particles in such trades as those of hairdresser,
baker, or stonemason.   Chronic granular pharyngitis, Granular
which is often the cause of this dry cough, is most suitably pharyngitis.
treated with some such mixture as the following :

> ℞.   Iodi   ...   .   gr. v.-xx.
> Potassii iodidi ...   .   gr. xx.-lxxv.
> Olei menthæ piperitæ ...   .   ♏i.
> Glycerinum   ...   .   ad ℥i.
>
> M.   Sig. : To be painted over the back of the throat night and
> morning.

Temporary relief may sometimes be obtained in this
condition by means of liquorice, cocaine, or morphia
lozenges, or preferably heroin in doses of $\frac{1}{12}$ to $\frac{1}{6}$ grain
three or four times a day.   Glyco-heroin may be given
in drachm doses.   Methylene blue in a solution of mag-
nesium sulphate is stated to be of value in this form of
cough, and in irritable conditions of the throat, if painted
over the pharynx twice a day.

A congested throat, when the tongue is clean, and the Congested
temperature but slightly raised, is frequently benefited by throat.
a mixture containing :

R. Tincturæ ferri perchloridi   ...   ...   ♏x.
    Potassii chloratis   ...   .   gr. x.
    Acidi hydrochlorici diluti   ...   ...   ♏v.
    Tincturæ aurantii   ...   .   ʒss.
    Aquam ...   .   ad ℥i.
        M. Sig.: To be taken three times a day.

Irritable throat.   If the throat shows no signs of disease, but is simply irritable, the cough is not infrequently relieved by heroin, or, when very persistent, by prescribing 20 to 30 grains of potassium bromide at night-time, as this drug undoubtedly acts on the upper air-passages as a sedative.

Tracheitis is not uncommon, and often yields to the following mixture :

R. Sodii bicarbonatis   ...   .   gr. xv.
    Acidi hydrocyanici diluti   ...   ..   ♏i.-ii.
    Syrupi pruni virginianæ   ...   ...   ʒss.
    Aquam destillatam   ...   .   ad ℥i.
        M. Sig.: To be taken three or four times a day.

It may be necessary to add a small dose of morphia in some cases; in others sodium sulphate may replace the sodium bicarbonate.

Pleuritic cough.   If the dry, hacking cough is due to pleuritic irritation, it frequently yields to appropriate remedies ; if the pleurisy is at the apex of the lungs, nothing is better than counter-irritation with equal parts of the solution and tincture of iodine, or by means of a blister; if the irritation is basal, nothing succeeds so well as effective strapping of the lower part of the chest. When we can find no cause for this dry cough, we are sometimes forced to treat it with anodynes, on the same principles as we may have to treat **Night cough.** what is described as the irritative night cough. We may try some simple linctus, such as :

R. Vini ipecacuanhæ   ...   .   ♏v.
    Spiritus chloroformi   ...   .   ♏ii.
    Tincturæ tolutanæ   ...   .   ♏v.
    Succi limonis   ...   .   ♏xv.
    Mucilaginem acaciæ   ...   .   ad ℥i.

    M.   Sig. : To be taken when required.

Or some form of simple lozenge, such as :

R. Extracti glycyrrhizæ   ...   .   gr. iii.
    Olei anisi   ...   .   ♏ss.
    Massæ trochisorum acaciæ   ...   ...   gr. x.

      M.

If these remedies are unsuccessful, we may try heroin, codeia, or some form of opium. When heroin given by the mouth—whether in the form of the simple drug or as glycoheroin—fails, it not infrequently happens that the injection of $\frac{1}{10}$ grain brings sleep, and so relieves the cough. The following linctus may be effective :

R. Acidi hydrocyanici diluti   ...   ...   ♏i.-ii.
    Liquoris morphinæ acetatis   ...   ...   ♏iii.-viii.
    Oxymellis scillæ ...   .   ℥ss.
    Aquam   ...   .   ad ℥i.

  M.   Sig. : A teaspoonful occasionally, but not oftener than
      six times in the twenty-four hours.

Or we may prescribe the morphia lozenge of the British Pharmacopœia, or a lozenge containing morphia and ipecacuanha.

We must not forget, however, that this incessant hack- Nervous cough. ing cough, whatever its origin, is not infrequently kept up by the morbid excitability of the nervo-muscular mechanism of respiration. In such cases food, stimulants, and nervous sedatives are the best remedies. Where the cough arises from stomachic troubles, gastric sedatives, such as Gastric.

hydrocyanic acid, or bismuth salts combined with vegetable bitters, may be prescribed. Sometimes a counter-irritant over the epigastrium is useful, or a gargle of fresh, effervescing soda-water may give relief. When the cough is **Bronchitic** due to some associated catarrh of the larger bronchial vessels, it may be advisable to promote expectoration for a few days by prescribing some alkaline mixture containing sodium bicarbonate, to which small doses of ammonium carbonate or potassium iodide may be added. If the mucus **Tenacious mucus.** is peculiarly tenacious, no drug succeeds so well as ammonium chloride in 10 to 15 grain doses three times a day, the taste of this medicine being disguised by liquid extract of **Profuse expectoration.** liquorice, etc. When the expectoration is profuse, creosote in capsules containing 1 to 3 minims may be given three times a day; better results are sometimes obtained with creosotal in doses of 5 to 20 grains, or with guaiacol carbonate in doses of 3 to 8 grains. The balsams, the terebinthinates, and preparations of tar, also tend generally to diminish the amount of secretion, but they are apt to make it more tenacious. Huggard speaks highly of the value of formaldehyde vapour in this condition ; it must be inhaled through the mouth, care being taken to protect the eyes and nose from its irritating vapours. In the later stages of consumption the secretion which accumulates in the cavities and larger tubes may give rise to much distress. No remedy removes this accumulated secretion so effectually and with such benefit to the patient as creosote in the form of vapour. In the final stages of pulmonary tuberculosis we have to rely very largely upon opium in some form or another for the relief of the cough and other distressing symptoms.

Tuberculous Laryngitis.

In the treatment of this complication no remedy gives such good results as fresh air at an even temperature. Many patients recover the use of their voice and show great improvement in the pathological conditions of the larynx under the open-air treatment. In the early stages a dry, bracing climate is useful, but in the later stages, when extensive ulceration and copious secretion are present, a more humid atmosphere gives better results. High altitudes should be avoided. We must insist on the importance of rest to the larynx in the majority of instances, the use of the voice being restricted as far as possible. Rest for the voice is of the greatest value, especially when the cords themselves are affected. Loud whispering is as great a strain as loud speech. Improvement in the laryngeal condition is often marked under the use of a slate and pencil or the deaf and dumb alphabet. All causes of irritation should be avoided, such as strong alcoholic drinks and highly-seasoned dishes. Smoking in many instances seems to act as a sedative, but should be avoided if it increases the cough. Cases of laryngeal tuberculosis may be divided into the following classes:

1. Those cases in which the disease in the lungs is slight, and is not advancing rapidly, and in which the general health is good. To this class may be added those cases in which the disease in the lungs is more advanced, but shows a tendency to improve. Mr. Harold Barwell, in writing of these cases, says that, however extensive the laryngeal disease may be, a cure is possible; and that if the disease is extensive and inaccessible by the mouth,

thyrotomy is advisable. In such cases the laryngeal lesion is seldom extensive, and usually consists of infiltration or superficial ulceration of one cord or of the interarytenoid space. Occasionally massive infiltration is present, and then brilliant results may be obtained by surgical means.

2. Those cases in which the disease in the lungs is so far advanced that it is unlikely to undergo arrest, but in which the disease in the lungs is chronic and unaccompanied by marked fever or debility. In the majority of cases of this kind active treatment of the laryngeal symptoms offers a good chance of local arrest.

The nature of both the pulmonary lesion and the laryngeal lesion must, however, be taken into consideration. For example, in a case of chronic but advanced pulmonary disease it is not necessary to curette a small tuberculous infiltration of the interarytenoid space, which only causes a little hoarseness and is not likely to spread rapidly. If, however, there is infiltration of the arytenoid region, which will soon cause dysphagia, or if there is a deep ulcer at the vocal process, which will sooner or later cause perichondritis and necrosis, active treatment is indicated.

3. Cases in which the disease of the lungs is so advanced that no real improvement of the latter condition can be expected. In these cases the treatment of the laryngeal lesion must be entirely symptomatic. Where there are no severe laryngeal symptoms in such cases it is improper to submit the patient to active treatment either with cutting instruments or strong caustic pigments. When dysphagia is present surgical measures are indicated.

We see, then, that the treatment of the laryngeal lesion must in part depend on the condition of the lungs and on the general condition of the patient. In saying this, it is necessary to call attention to the fact that in laryngeal disease the extent of the pulmonary disease may be largely or even completely masked. With these reservations, we may now consider the treatment of tuberculous laryngitis according to the pathological condition which is present.

Ulceration and Granulation. — Antiseptic and caustic pigments are of great value, but must be thoroughly and forcibly rubbed into the affected parts, as a light painting is of little service. When there is ulceration or much secretion, the larynx should be sprayed and kept clean ; for the removal of the secretion is essential before any form of local treatment can be employed. Alkaline waters, such as Ems water or a solution containing 10 to 15 grains of sodium bicarbonate to an ounce of water, are useful for this purpose, either in the form of a spray or as an inhalation. If the secretion is offensive, some antiseptic may be added. In such cases the following is of service :

R. Sodii bicarbonatis ...   . gr. x.
    Sodii chloridi   ...   . gr. v.
    Glycerini acidi carbolici ...   ... ʒi.
    Aquam   ...   . ad ℥i.

No local anæsthetic is necessary before the application of pigments ; the frequent use of cocaine has a most harmful effect on the appetite and general health. In very irritable cases a little 5 per cent. solution of cocaine

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may be sprayed on to the pharynx until the patient be-
comes accustomed to the manipulation. The best pigment
is Lake's, consisting of lactic acid 50 per cent., formalin
7 per cent., and carbolic acid 10 per cent. The carbolic
acid acts as a local analgesic, and the smarting after
application seldom lasts longer than a few minutes. The
mixture should be applied daily, if possible, on a strong
cotton-wool mop. When this solution causes irritation,
or when healing is almost complete, it may be diluted
with an equal quantity of water. If the granulation or
ulceration do not yield to this treatment, curetting must
be employed in addition.

Massive Infiltration.—Here it is necessary to use punch
forceps under cocaine anæsthetization. This procedure
should be followed by the application of Lake's solu-
tion, mentioned above, or, when there is little prospect
of healing, by insufflation with equal parts of orthoform
and amyloform.

Dysphagia.—In this distressing condition the use of
cocaine and morphia is insufficient, and should only be
used when the case is near its termination. For its relief
surgical measures rank high above analgesics, and the
results are so satisfactory in capable hands that no
patient should be allowed to die from the mere dysphagia
of tuberculous laryngitis. These surgical measures con-
sist of the removal of the epiglottis or the clipping
away of a small piece from the swollen arytenoid. The
operation takes a very short time, causes little disturb-
ance, and generally gives immediate relief. Subsequently
orthoform should be employed.

DYSPNŒA.

Dyspnœa is occasionally a distressing feature of advanced consumption. Inhalations of oxygen may be of service; in other instances diffusible stimulants, such as brandy, ammonia, and ether, may afford relief.

Recently I have found that the treatment first suggested by Dr. Alexander Francis for asthmatic dyspnœa has led to a very considerable amelioration of this distressing condition in certain instances. This treatment consists in lightly cauterizing the nasal septum. Better results are said to be obtained when the nasal mucous membrane is healthy than when some diseased condition is present.

HÆMOPTYSIS.

Hæmoptysis occurs in the early stages of consumption as the result of hyperæmia, or of disease of the minute vessels, and in the later stages as the result of the rupture of one of the larger vessels, owing to the perforation of an aneurismal dilatation in the course of a vessel through a cavity. The treatment of these two conditions differs in certain important particulars, and must be discussed separately.

(*a*) Hæmorrhage from congestion or hyperæmia subsides spontaneously, in the great majority of instances, and does not necessitate any very active treatment. In all cases we must endeavour to relieve the minds of the patient and his friends. If the sputum is merely tinged with blood, or the quantity of blood be small, it may not be necessary to do more than to caution the patient against exertion for a few days. When the quantity

Hæmoptysis from congestion.

is larger, it is as well, especially if the patient is alarmed or restless, to inject $\frac{1}{4}$ to $\frac{1}{3}$ grain of morphia at once. If, however, the hæmorrhage is severe, we must employ morphia with caution, as this drug diminishes the sensitiveness of the bronchial tubes, and the blood may consequently pass into other portions of the lungs with disastrous consequences. The essential points in the treatment are that everything should be done to favour thrombosis of the vessels, and to prevent further hæmorrhage. Absolute rest is, therefore, imperative. The patient should be confined to bed, and should be forbidden to speak above a whisper; no useful information is gained at this stage from a physical examination, if the diagnosis is known, and percussion should on no account be practised, for fear of dislodging a clot, and so leading to a recurrence of the bleeding. The best means of avoiding further hæmorrhage are those which tend to lower the blood-pressure. Free purgation should, therefore, be practised by means of saline mixtures. Alum and dilute sulphuric acid probably help the coagulation of the blood. If the bleeding continues, calcium chloride in 5-grain doses thrice daily may be tried. In more serious cases calcium chloride may be given in 15-grain doses; and when this has no effect, a dose of 60 grains, given immediately after a hæmorrhage, sometimes produces the desired result. Elliott writes favourably of the effect of small doses of aconitin when the pulse-rate is high and arterio-sclerosis is present. Amyl nitrite inhalations, or inhalations of turpentine, or oil of turpentine ♏x on a piece of sugar are well spoken of by some authors. Ice-bags to the heart may be of service in diminishing the action of

this organ, but can do no good when applied over the lungs; in fact, post-mortem records show that they have sometimes been applied—in ignorance of the localization of the lesion—to the wrong side. Drugs which promote the contraction of bloodvessels are injurious in this condition; for if the arteries from which the hæmorrhage has taken place are diseased, they are unlikely to retain any contractile power, and the general rise in blood-pressure, brought about by the increased peripheral resistance, can only tend to increase the hæmorrhage. Ergot raises the general blood-pressure, and probably does not cause contraction of the arteries in any part of the body except in the uterus, and therefore should not be given. Digitalis raises the blood-pressure, and should only be prescribed when the action of the heart continues to be unnecessarily rapid. Lead is a favourite remedy, and may be of great service, chiefly because it diminishes the force, and especially the frequency, of the heart's action.

Food should be withheld altogether for the first few hours; milk may then be given frequently in small quantities, not more than 2½ pints being taken in the first twenty-four hours. It should be given cold rather than hot, so as not to excite the action of the heart. Small lumps of ice may be sucked if the patient is parched or troubled by cough, but care should be taken that the amount given is not sufficiently large to cause flatulence. In some cases, when the pulse remains very feeble, when there is much tendency to faintness or when the patient shows little power of reaction, diffusible stimulants well diluted may be cautiously employed.

My practice in the majority of instances is to inject a

small dose of morphia at once. I endeavour to reassure the patient, and keep him absolutely at rest for at least twenty-four hours, and in bed for a few days after all hæmorrhage has ceased. I usually prescribe the following mixture, which may be taken with advantage three or four times a day :

    ℞.   Aluminis ... ... gr. x.-xv.
           Magnesii sulphatis ... ... gr. xx.-ʒi.
           Acidi sulphurici diluti ... ... ♏xv.
           Tincturæ cardamomi compositæ ... ʒss.
           Aquam chloroformi ... ... ad ʒi.
                    M.

When there is a paroxysmal cough in addition to the hæmorrhage, it should be checked by sedatives; the following linctus is of service :

    ℞.   Liquoris morphinæ acetatis ... ... ♏viii.
           Acidi hydrocyanici diluti ... ... ♏ii.
           Succi limonis ... ... ♏xv.
           Mucilaginem acaciæ ... ... ad ʒi.
   M. Sig. : A teaspoonful to be slowly sucked when the cough is troublesome, but not more frequently than six times in the twenty-four hours.

If the progress of the case is satisfactory, I prescribe dilute sulphuric acid with the compound infusion of gentian, and also insure a satisfactory action of the bowels. As the hæmorrhage ceases, there is sometimes a certain amount of bronchial catarrh, and the removal of the blood from the lungs may be assisted by the administration of small doses of ipecacuanha or antimony. In other instances the extravasated blood leads to the development of a localized broncho-pneumonia, which is associated with a rise of temperature, and is usually of favourable import.

(*b*) Hæmorrhage into a cavity due to the rupture of an aneurismal dilatation of one of the large vessels must be treated by absolute rest. If the position of the hæmorrhage is known, the patient should be placed on the affected side, to prevent in some measure the blood being drawn during inspiration into the opposite lung. An injection of ⅓ grain of morphia should be given at once unless there is marked collapse. No purgative should be given at first, for the movements attending evacuation of the bowels in severe cases may cause a renewal of the hæmoptysis. After twenty-four hours the bowels should be moved by means of an enema, and then a saline mixture should be prescribed. Ergot in such cases may have disastrous results—in fact, no drugs with the exception of opium, or possibly calcium chloride, in the doses mentioned above, can be of service. The essential treatment is absolute rest, and in these more serious cases we must insist on this measure being adopted for at least a week after the cessation of all signs of hæmorrhage.

DISORDERED DIGESTION.

In any case of disordered digestion the condition of the teeth should receive careful attention. As Knopf observes, the appetite is often increased if the patient brushes his teeth with mouth-wash after meals, such as listerine or the following :

℞.	Essentiæ menthæ piperitæ	...	...	♏x.
	Olei gaultheriæ ...	...	...	...	♏xv.
	Thymol ...	...	...	...	...	gr. xv.
	Acidi benzoici ...	...	...	...	ʒiii.
	Tincturæ eucalypti gummi	...	...	ʒii.
	Spiritus rectificati	...	...	...	℥xv.

M.   Sig. : Half a teaspoonful to be mixed with a tumblerful of water and used as a mouth-wash.

Solid food should always be given if possible. When the patient cannot take solid food he should have absolute rest. Careful attention should be paid to the bowels, but too drastic remedies must be avoided, or an intract-

Anorexia.   able diarrhœa may be induced. If there is anorexia, fresh air is the best prescription. In many instances alcohol in the form of brandy or champagne is of great service. The following mixture of the Brompton Pharmacopœia is often useful :

        R.   Sodii bicarbonatis   ...   . gr. xv.
            Acidi hydrocyanici diluti   ...   ... ♏iii.
            Infusum gentianæ aromaticum   ... ad ℥i.
     M.   Sig. : To be taken with an equal quantity of water half
            an hour before the mid-day and evening meals.

In some forms of anorexia great benefit is obtained from small doses of creosote or its derivatives. In other cases, where there is a loss of appetite and distension after food, a mixture containing dilute hydrochloric acid and strychnine is sometimes successful when taken before meals. The persulphate of sodium, either chemically pure or in the form known as persodine, may be of service in increasing the appetite when given in doses of a table-spoonful once, or at most twice, a day.

Distension.   In some individuals the feeling of distension after meals may be relieved by 5 grains of pepsin or pancreatin, alone or in combination with 2 grains of bismuth carbonate and 1 grain of powdered ipecacuanha. If these measures fail, we may prescribe an antiseptic, such as sodium sulpho-carbolate in doses of 10 to 15 grains, or small doses of creosote, or we may try the following prescription :

R. Sodii bicarbonatis ... ... gr. xv.
    Spiritus ammonii aromatici ⎱ ... ... āā ♏xx.
    Spiritus chloroformi   ⎰
    Infusum caryophylli recentum ... ʒi.
  M. Sig.: To be taken twice a day an hour after food.

Acute dyspeptic pain should be treated with bismuth ^{Acute pain.} in full doses, which may be combined sometimes with $\frac{1}{16}$ to $\frac{1}{12}$ grain of morphia. If a distressing cough follows, or if vomiting is induced, when food is taken, relief may sometimes be obtained by the use of counter-irritants, such as a flying blister applied to the epigastrium, or a solution of equal quantities of the solution and tincture of iodine painted over the exterior of the larynx or over the diseased portion of the lung. Effervescing mixtures of hydrocyanic acid, with or without bismuth carbonate, or drop doses of arsenic, may be useful. In some instances we may have to wash the stomach out and feed the patient with the following mixture of Debove's : $1\frac{1}{2}$ pints of milk, an egg, and 3 ounces of very finely powdered meat, three times a day.

DIARRHŒA.

Diarrhœa in the course of consumption may arise from ordinary causes, or may be due to tuberculous ulceration of the intestine. Whenever this symptom is present, it should receive immediate attention, all laxative articles of food should be omitted, and farinaceous and milk foods should be prescribed, together with intestinal antiseptics and astringents. Given in ounce doses with milk three or four times a day, lime-water is useful. In most cases a tablespoonful of castor-oil may be employed in the first

place to remove any irritating or decomposing material. In diarrhœa due to tuberculous ulceration, alcohol should be freely prescribed. Large quantities of pure red wine are sometimes invaluable. A most useful drug in this condition is tannalbin, in 10 to 15 grain doses; if this fails, bismuth nitrate or carbonate, in doses of 20 to 30 grains, with or without small doses ($\frac{1}{16}$ to $\frac{1}{12}$ grain) of morphia, may be tried. It is important to give large doses both of the tannalbin and of the bismuth, and to repeat them every four hours until the symptom abates. If the diarrhœa continues, other remedies, such as Dover's powder in 10-grain doses, an enema of starch and opium, or 5 grains of the compound lead and opium pill, may be employed. Kingston Fowler recommends the fluid extract of coto bark, in doses of 5 minims, combined with compound tincture of cardamoms and mucilage, as an efficient remedy in advanced cases.

Pain.

The treatment of pain will naturally depend upon its cause. Pain in the region of the right shoulder, for example, may be referred from the stomach, and may only yield to gastric sedatives. If the pain is due to pleurisy, the most efficient remedy is strapping well applied, so as to limit the respiratory movement; if due to muscular tenderness, a flying blister, or the application of iodine or other counter-irritants, is indicated. If, as not infrequently happens, the pain is due to tenderness of the diaphragmatic attachments brought on by an exhausting and irritable cough, we must prescribe a sedative linctus.

Night-Sweats.

This symptom always disappears when the patient has an abundance of fresh air and good food, and medicinal remedies are seldom required. The sweating is caused by exhaustion, or it occurs as the bodily temperature falls. In some cases simple sponging with an evaporating lotion is sufficient, or a course of tonics may be tried. If the symptom becomes distressing, atropine in doses of $\frac{1}{100}$ to $\frac{1}{50}$ grain, or a pill containing $\frac{1}{4}$ grain of the alcoholic extract of belladonna, together with 4 grains of zinc oxide, may be tried; but these preparations tend to produce dryness of the mouth. Other remedies are aromatic sulphuric acid 30 minims, nitrate of pilocarpine $\frac{1}{20}$ grain, picrotoxine $\frac{1}{60}$ grain.

Pityriasis Versicolor.

The commonest skin affection in consumption is pityriasis versicolor. It is harmless, but sometimes distresses patients. The surface of the skin should be washed with soap and water, and, when dry, moistened with vinegar and water, or dilute acetic acid, and then well sponged with a solution of a drachm of sodium hyposulphite to an ounce of water. Three applications of this, or similar parasiticides, are usually sufficient, although outlying patches may require further treatment.

Pneumothorax.

Pneumothorax must be treated by absolute rest, and in most cases the affected side should be strapped so as to limit the movements of the chest. When there is great collapse, stimulants, especially hypodermic injections of

ether, should be given.   Morphia should be injected when-
ever there is much cough, dyspnœa, or distress.   If fluid
accumulates in any quantity, or if suppuration follow, the
case must be dealt with on surgical lines.

Fistula in Ano.

The question often arises whether an operation should
be performed on a fistula when this occurs in a consump-
tive person, as it not uncommonly does, more especially
in males.   In former days it was the practice of most
physicians and surgeons to leave a fistula alone when it
complicated consumption, chiefly because it had been
observed that, when a fistula was discharging freely, the
tuberculous mischief was frequently quiescent, whereas
when the discharge became less the pulmonary disease
was more active.   Probably, in those instances in which
the discharge from the fistula is diminished, and the
pulmonary disease in consequence more active, a greater
amount of the morbid products of the tubercle bacilli is
absorbed from the diseased tissues in the neighbourhood
of the rectum, and the general resistance of the body is
lowered.   We have learnt that anything which lowers the
resistance of the body enables the disease in the lungs to
make further progress, and that we must endeavour to
avoid, or remove, anything which is likely to cause this
effect ; consequently we should endeavour to avoid the
unnecessary absorption of deleterious products.   It was
further urged in former days that an operation on a fistula
in a consumptive patient was often followed by disastrous
results.   These latter were not, in my opinion, entirely
due to the operation itself, but partly to the fact that the

Practice in
former days.

cases operated on were not always judiciously selected, and that the operation could not be as effectually or thoroughly performed as it can be, owing to the advances of surgery, at the present time. Further, in former days sufficient attention was not paid to the hygienic preparation and after-treatment of the patient on open-air lines, nor was the importance of the particular kind of anæsthetic to be employed sufficiently realized.

In view of the above, the practice of most surgeons in regard to this complication is somewhat different to what it formerly was.

When the fistula is associated with active pulmonary tuberculosis, no attempt should be made to cure the trouble, and as little as possible should be done. Sometimes the discharge is so weakening, and the mental distress is so great, that the fistula causes more harm than an operation of a palliative nature. Further, the mental distress is much enhanced if the patient learns that his condition is too precarious for an operation to be permitted. In many instances, therefore, an incision should be made from the outside into the cavity of the fistula, and the fæces collected there should be allowed to escape, in order to mitigate the pain. *Treatment when active disease is present.*

If the pulmonary disease is quiescent there is no reason why an operation should not be performed, provided that there is a reasonable expectation of a cure—that is, if all the diseased tissues can be removed. In any quiescent case, if the fistula is causing much trouble or mental distress, and so interfering with the patient's progress, an operation becomes necessary. *When the disease is quiescent*

Apart, then, from purely palliative measures, no patient

should be operated upon until the pulmonary disease is quiescent. Chloroform should be chosen as the anæsthetic in preference to ether, as this latter agent is liable to set up irritation of the lungs, and sometimes leads to cough, which is always detrimental in this complication. It is important that patients should continue to live under hygienic conditions immediately after the operation.

OTHER SYMPTOMS AND COMPLICATIONS must be treated on general principles as they arise.

CHAPTER IX

SPECIAL CONSIDERATIONS

SHOULD ALL CASES BE TREATED AT A SANATORIUM?

EVERY patient suffering from consumption is well advised
if he goes in the first place to an efficient sanatorium,
provided that his general condition is suitable and the
disease not too far advanced. In this way he learns, as Treatment
learnt best at
in the great majority of instances he can learn by no other a sanatorium.
means, the necessary routine and the immense importance
of apparently insignificant details. At the same time he
is removed from many unnecessary temptations which
a luxurious home and injudicious friends invariably offer.
When he has learnt the kind of life he has to lead, and
when the disease has become quiescent and afebrile, he
may be allowed to continue the treatment at his own
home.

The first point for consideration is whether the patient
is in a fit condition to be sent from home. The sanatorium
treatment has met with so much deserved success, and All cases are
not suitable
has appealed so forcibly to the lay mind, that many for treatment
at a sana-
physicians have yielded to the importunities of the torium.
patients' friends, and sent most unsuitable cases to
sanatoria. It must be borne in mind that, though
sanatorium treatment is the best at our command, it has

its limitations ; in many cases it can arrest the progress of the disease, and stamp out the tubercle bacilli, but it cannot create new lung tissue, nor restore an extensively diseased lung to a full working capacity for an indefinite period of time.   At many efficient sanatoria the physician in charge accepts all patients except those in an obviously moribund condition, and a certain number of those in whom advanced disease is present improve to a remarkable extent.   There can be no doubt that when the disease is advanced, just as good results may be obtained by skilled physicians at the patients' own homes.   Such patients should be treated at home, more especially as in this way much mental distress is avoided if a fatal issue occurs. Nothing, in my opinion, should be more strongly condemned than the practice of sending patients with extensive disease of both lungs, high temperature, and marked wasting, long journeys to distant sanatoria or health resorts, to drag out a miserable existence among strange surroundings.

Cases unsuitable for Sanatoria.

We should never despair in the treatment of pulmonary consumption.   Even those patients who are too ill to be sent to a sanatorium should be treated on hygienic principles.   At the same time, if recovery is out of the question, we must direct most of our efforts to euthanasia, smoothing the road to the inevitable end.   It is difficult Unsuitable cases. to lay down rules as to the unsuitability of particular patients for treatment in a sanatorium, for each case should be considered on its individual merits, as so much depends on the character of the home surroundings.   In

my opinion, individuals with extensive excavation in both lungs or with the persistent diarrhœa of intestinal tuberculosis should not be sent to a sanatorium, nor should cases with high fever and great debility—at any rate, until these symptoms have yielded to treatment. Patients suffering from chronic alcoholism should be kept at home. The same statement applies to patients who have severe cardiac complications, or who are suffering from diabetes or chronic albuminuria.

The following sanatoria receive patients in all stages of the disease, except those who are obviously moribund : Class of case refused by various sanatoria. Nordrach Colonie, Rudgwick, Cotswold, Montefiore Home, Friedrichsheim, Hohenhonnef, Rossclare, Zarskoje Selo, Dunstone Park, Grampian, Holne Chase, Vale of Clwyd, Nordrach - in - Wales, Linford, Guimar, Rostrevor. At other institutions individuals with advanced disease are not admitted; for example, at Loslau, Waldof-Elgershausen, Falkenstein, Reiboldsgrün, Moorcote, Chico Springs, Luitpoldheim, Ruppertshain, Halila, Braunwald, Sülzhayn, Reknaes, Consumption Sanatoria of Scotland, Belzig, Nordrach-on-Dee, Hauteville, Whitehaven, Laurentian, Nordrach-on-Mendip, Loomis, Davos-Dorf, Durham, Canigou, S. de Pins. The authorities at other sanatoria, such as Adirondack, refuse patients with cavitation ; at de Trespoey laryngeal cases are not admitted. At the East Anglian Sanatorium patients afflicted with chronic alcoholism are refused; at Montana, those with cardiac or asthmatic affections. At others, such as Crooksbury, patients are not admitted—(1) who are moribund ; (2) who have both bases affected ; (3) who are suffering from active laryngeal tuberculosis ; (4) who have a temperature over 103° F.

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Admission to the majority of the sanatoria for the poor in England is at present restricted to those suffering from the disease in its early stages, because in this way more patients are treated and the good done in individual instances is more permanent.

THE SELECTION OF A SANATORIUM.

In deciding on a particular sanatorium for a patient two considerations must guide us : (1) The character of the medical man in charge.; (2) the climate and position of the institution.

The character of the medical man in charge.

Sufficient has been said in the previous pages to show that the success of the open-air treatment depends largely upon the character and perseverance of the physician. It is hardly necessary to add that patients should not be sent to sanatoria of which their advisers have no personal knowledge, for it is an unfortunate fact that many so-called sanatoria are in reality hotels, and are· established for profit rather than for the relief of patients, whilst at others discipline is not maintained, or the methods adopted are ineffectual. It sometimes happens that a sanatorium which is most efficiently conducted when first opened, does not maintain its high standard when its successes have become extensively recognised ; consequently, we must have recent knowledge of any institutions to which we send our patients.

Climate.

With regard to the climate and position, I would say at once that most physicians who have had much experience of sanatorium treatment, and who have watched patients for some years after their return from a sanatorium, agree that as far as possible *all patients should be treated under the*

same climatic conditions as those which they are likely to experience in their subsequent life. Against this view it may be said that some patients in whom there are few or no physical signs do well at high altitudes, and on returning to ordinary conditions suffer no harm. Such patients, however, would do well under any climatic conditions within certain limits. Patients with more extensive disease should not be sent to elevations over 1,500 feet unless they are prepared to spend the remainder of their life under similar circumstances. Patients with much emphysema or albuminuria should never be sent to high altitudes, nor should those with marked cardiac irritability. Further, Wolff-Innermann has found that the altitude of Reiboldsgrün (2,300 feet) is not infrequently unsuitable, even in the early stages of the disease.

The chief climatic requirements, as we have seen, are that the air should be pure and free from dust, and that there should be a sufficient amount of sunshine, together with shelter from the wind. Some authorities insist on an equable temperature; others, more enthusiastic, assert that no variation of temperature, however great or sudden, matters. There can be no doubt that the best and most permanent results are obtained in cold, bracing climates, rather than in warm or tropical ones, and certainly the great majority of English patients will do well to avoid warm climates, more especially when these are moist. Many patients dislike the discomfort of an English winter, more especially during the months of January, February and March. If time and money are matters of consideration, consumptive patients should in most cases remain under the climatic conditions to which

they are likely to be exposed in future winters, notwithstanding a certain amount of discomfort. On the other hand, if a patient is possessed of ample means, there is no reason why he should not winter abroad, provided that the locality is chosen judiciously, and provided also that the patient continues to carry out the treatment in all its details. It is the fashion at the present day in the treatment of tuberculosis to disregard all meteorological factors; but the reaction of different people, even in health, varies considerably in reference to climatic conditions, and it is certain that tuberculous individuals are no exception to this rule. I have known patients who failed to make progress at a most efficient sanatorium, situated at a slight altitude, improve at a similar institution at a lower level. It is a good plan for some patients to spend a few months at one sanatorium, and then go to another, provided both are efficient, as change of air and surroundings are often successful in producing further improvement when the progress of the healing processes in the lungs seems to have temporarily ceased. We must always study the individual peculiarities of our patient, and send him to a sanatorium where the climatic conditions are similar to those which have previously been of service to him. Patients with much catarrh may require a climate with a considerable amount of humidity: other patients with a

Position.   dry cough may do better with a dry, crisp air. Care should be taken that the position of the selected sanatorium is such that the journey may be taken without causing the patient undue exertion or fatigue.

How long should the Hygienic or Sanatorium Treatment be continued?

Patients should be under the immediate supervision of a medical man until all signs of active disease have disappeared, and until the presence of tubercle bacilli can no longer be demonstrated in the expectoration by staining methods or by means of inoculation. This result is achieved, on the average, with careful and continuous treatment, in five to six months in cases which were in an early stage of the disease at the commencement of treatment; but occasionally two years or longer may be necessary. Those individuals who have sufficient character and determination to carry out the necessary treatment for themselves, in all its details, may be permitted to do so after two months' training.

The chief indication that the disease is permanently arrested is the restoration of the working capacity, and a definite decision cannot be given on this point at an earlier date than two years after the apparent arrest of the disease. Patients, on passing from medical supervision, should be told that for at least two years they must continue the same plan of treatment in its main details, so far as is possible; that they must avoid all severe strain upon the respiratory or other organs; and that they must not frequent places where a large number of people are gathered together, such as theatres, concert-rooms and churches. A man must not think that, because his temperature is normal, and the physical signs are those of quiescent disease, he is necessarily cured. In giving advice on this point, we do well to remember that *in consumption the*

Indications that the disease is arrested.

Absolute arrest requires a long period of treatment.

*disease is always more extensive than the physical signs would
lead us to suppose.* An individual whose disease has
fortunately been arrested must be made to understand
that he is still a weak vessel, and cannot at once indulge
in the ordinary pursuits of healthy people, and that he is
liable to further infection or relapse, if he is not careful,
for some considerable time. He must not cry, ' The war
is over,' or he will find that tubercle bacilli, like the Boers,
suddenly swoop down from their kopjes, with the result
that an unfortunate incident occurs, and perhaps absolute
disaster. .

Patients must
continue to
lead healthy-
lives.

Patients must not return to unsuitable surroundings,
nor to unsuitable occupations ; they must still have fresh
air and good food, and must not be exposed to un-
necessary fatigue. It is a common thing for patients to
be told on leaving a sanatorium that they must give up a
city life and find some occupation in the country. This
advice is, no doubt, ideal. Many considerations have,
however, to be kept in view. For example, a man who
has earned his livelihood in a city may be quite unable to
do so in the country. Again, many country pursuits involve
far more physical exertion than a city occupation. No
man should be recommended to adopt a new life which
not only involves more physical strain, but also a financial,
and therefore mental, one. In my experience, cases of
arrested consumption in many instances do much better,
when reasonable care is taken, in their former city occu-
pations than if a radical change is made and a country
life substituted. For example, a man who has been a
clerk in the City of London may be permitted to return
to his work, if he will take care to have a reasonable

supply of fresh air and to avoid undue fatigue. Such cases are well advised if they give up the luncheon hour to complete rest, eating sandwiches rather than going out for lunch to a restaurant. Patients should, as a rule, not be recommended to travel daily by train from the country to the town in which they work; they will do better to live in the town.

It is important that patients should be thoroughly examined by their medical advisers at least once in every three months for a year or two, so that any return of the disease may be detected at the earliest possible moment.

Should Tuberculous Individuals marry?

It is obvious that, when there is active disease or much febrile disturbance, matrimony is inadvisable for consumptive people. In women with active disease parturition usually hastens the pathological processes, and Dubois goes so far as to say, 'If a woman is threatened with tuberculosis and marries, she may bear the first accouchement well, a second with difficulty, a third never.' Every case must be considered on its individual merits, and an opinion should not be expressed until all the details of the patient's health and surroundings have been duly weighed. Naturally, marriage should not be advised if the patient's means contra-indicate it, nor if it is likely to increase his anxieties and the necessity for work. On general principles, however, it may be said that, as soon as the disease has become arrested, tubercle bacilli have disappeared from the sputum, and constant medical supervision is no longer required, consumptive individuals

may be advised to marry, provided that they are able to live under suitable conditions. This is not the advice which is usually given, but I am convinced that by means of marriage tuberculous individuals are enabled to lead a more regular life, and to avoid various forms of temptation to a greater extent than in any other way, whilst at the same time the husband, or wife as the case may be, feels that a greater responsibility rests upon him to maintain his health, and, consequently, continuous care is more frequently taken. It is true that cases of infection being conveyed from husband to wife are on record. Sir Hermann Weber's cases are well known : nine husbands, tuberculous before marriage, lost eighteen wives : one lost four in succession, one three, four two, and three one each. The wives in these instances were, with one exception, healthy at the time of marriage. Such infection, however, can only occur when there is active disease together with expectoration of tubercle bacilli, and when proper precautions with regard to the disposal of the sputum are neglected. When the disease is quiescent and the ordinary hygienic rules already discussed are adopted, there is little danger of infection in this manner.

Infection from husband to wife.

Marriage is often prohibited on the ground that the children will become tuberculous, not, indeed, by direct transmission of the bacillus to the child before birth, for this is an extremely rare event, but by the transmission of a suitable soil—that is, the necessary receptivity of the tissues—and subsequent infection with the bacilli. This view is based on the supposition that the offspring of tuberculous individuals are more frequently afflicted with consumption than the offspring of others. Such a view,

Transmission of the disease to children.

however, rests on slender evidence. Squire and others have shown by a careful investigation of a large number of cases of consumption, special precautions being taken to avoid the many errors which creep into the investiga- tion of family histories, that the difference in the incidence of the disease in the offspring of tuberculous and non-tuberculous parents is very small. This author examined 1,000 families, comprising 6,400 children. He obtained the following figures : ' Percentage of the offspring of phthisical parents subsequently becoming tubercular, 33·16; percentage of the offspring of non-phthisical parents subsequently becoming tubercular, 23·65 ; percentage influence due to parents, 9·51.' These statistics are remarkable, as the children of tuberculous parents who are the victims of active disease must in most cases, unless the necessary precautions are taken, be more exposed to the risk of infection. They would appear to suggest that the children of tuberculous parents possess some natural immunity to the disease, for otherwise the percentage of children who develop tuberculosis should be much greater when the parents suffer from the disease than when they do not. Such a view receives some support from experimental and clinical evidence. We know, for example, that animals may be made immune to a disease such as anthrax, that this immunity may be transmitted to the next generation or generations, and that it is dependent on some subtle chemico-physiological change. It is also a fact that, when a disease such as measles or syphilis has been endemic in a country for a long time, it becomes milder in type, whereas if it is introduced into a country in which it has been previously

unknown, it is of an extremely virulent form, and causes a large percentage of deaths. There is no reason to suppose that tuberculosis does not follow this law. Further, whilst the blood of patients in an early stage of tuberculosis will not cause tubercle bacilli to agglutinate or gather in clumps, yet the blood of patients suffering from advanced disease will do so; that is to say, some substance is manufactured, or some property is acquired, as the disease progresses, which acts as a protection against tubercle bacilli and brings about their agglutination. It is possible that this effort on behalf of the system towards immunity may be more successful in some instances than others, and that it may be transmitted to the offspring. Clinical support of this view has been furnished by

King's observations. H. Maxon King of New York University, who has contributed a suggestive paper on the subject, based on observations made in 242 cases of tuberculosis which occurred in his own practice, in all of which he had exceptional opportunities for learning the family history. King showed that in these cases the percentage of individuals with a tuberculous parentage was smaller than that of those with a non-tuberculous parentage. He also found that the children of tuberculous parents, when attacked by disease, showed a greater resistance to the disease and a stronger tendency to recover than other persons. These are remarkable observations, and merit careful investigation. Children of tuberculous parents are certainly more exposed to infection, but it would seem possible that they are more resistant to the disease than other children, and this fact may to some extent account for the diminishing mortality from tuberculosis.

There can, indeed, be no doubt that many persons are constitutionally more liable to tuberculosis than others, and that this in many instances is due to hereditary causes. There is not sufficient evidence to show that this is due to tuberculosis in the parents, and we are tempted to conclude that, if reasonable precautions are adopted, there is no reason why the children of tuberculous parents should develop the disease more frequently than the off-spring of those who are not tuberculous.

PROGNOSIS.

A wise physician never gives a prognosis in a case of tuberculosis. This rule is a difficult one to follow in practice, but no opinion should be expressed until we have had the patient under observation for a considerable time, and have thoroughly mastered the individual pecu-liarities of the case. If we could determine the exact degree of virulence of the bacilli in a particular case, if we could express by means of an algebraical formula the exact resisting power of the individual, and if we could foresee all future contingencies, such as the general char-acter of the patient's actions and surroundings, we might be justified in forming a judgment on the question of prognosis. The most important factor to know is the resistance power of the individual. A man in whom there has been a previous attack of tuberculosis, which has become arrested, shows that at one time his body possessed the power of manufacturing the necessary anti-toxins. In a case in which we have no history of the kind to help us we must wait until we have seen the effect which treatment brings about before giving an opinion.

Difficulties in giving an opinion.

Anyone incapable of a sustained effort, or incapable of seeing the value of the treatment advised, rarely obtains complete arrest of tuberculous disease. Apart from the question of character and of resistance to the tuberculous toxin, the prognosis of any case must be guarded, for anyone suffering from pulmonary tuberculosis is, so to speak, on the edge of a precipice, and may at any time suffer from severe hæmoptysis or from pneumothorax.

There are, however, always too many uncertain factors in the problem for our solution to be more than approximate. We may in some instances form an impression, and give a provisional opinion based on the general character of the patient and his physical signs, but any judgment must be dependent upon the patient's rigid adherence to the course of treatment laid down for him. Much also depends on the individual's character, and on the question whether he has a strong motive to get well.

Case.

We must not forget that many apparently desperate cases recover in a surprising manner. Thus, a gentleman with extensive disease in both lungs, who had been confined to bed for more than a year, consulted a number of medical men in New York, in order to ascertain whether there was any chance of his surviving the journey to Paris, as he was anxious to go there in order to see his mother before he died. Fifteen physicians told him the journey was beyond his strength; the sixteenth thought that possibly the voyage would benefit him. He determined to make the attempt, and made elaborate preparations, even taking his coffin with him on the voyage. He arrived in Paris in an extremely feeble condition. His mother then

persuaded him to go to a sanatorium which has a world-wide reputation. He did so, and at once began to show improvement. This has been so great and so well sustained that he is now able to walk twenty miles with comfort.

Other patients who are apparently doing well suddenly lose ground. For example, a picture-cleaner came to my out-patient department with the signs of early pulmonary tuberculosis. He was advised to live an open-air life under suitable conditions. He did so for three months, and the disease became quiescent. Two months later he overexerted himself, and had three slight attacks of hæmoptysis on successive days in Warwickshire. He was kept at rest, but, in spite of everything that was done for him, the attacks of hæmorrhage continued, and he died within six weeks of the onset of this symptom. *Case.*

The best guides to the prognosis in any individual case are the character of the patient and the way in which he reacts to the hygienic or sanatorium treatment. Consumption is an eminently curable affection, and, provided that the disease is treated judiciously in a sufficiently early stage, and that the details are continuously followed, the prognosis is uniformly good. When the disease is more advanced, a more prolonged course of treatment is required, and the outlook is less satisfactory. Cases in which the onset is pleuritic usually tend to run a favourable course if the patients are willing to undergo the necessary treatment. Recurrent hæmoptysis, a persistently rapid pulse, persistent anorexia or diarrhœa, albuminuria due to infection of the kidneys, rapid spread of the disease or extensive softening, pneumo- *Symptoms of grave significance.*

thorax, the existence of tuberculosis in other organs of the body, or the presence of complications such as diabetes, are all of grave significance. Cases of tuberculous disease in which the onset is acute frequently have a fatal issue. On the other hand, in a certain number of such cases the disease eventually becomes completely arrested.

APPENDIX I

THE EXAMINATION OF SPUTUM FOR TUBERCLE BACILLI

A. DIRECT METHOD.

1. POUR the sputum into a watch-glass, placed on a black surface.

2. Select a purulent portion of the sputum—about the size of a pin's head—and place this on a *clean* cover-glass.

3. Place a second cover-glass on this, and hold the two between two folds of blotting-paper. Squeeze them together, and then gently slide them apart.

If the sputum is viscid, there is sometimes a difficulty in doing this. One of the following plans may then be tried :

(*a*) Before separating the covers, pass them *once* rapidly through a spirit flame.

(*b*) Mix the sputum with a strong solution of ammonium carbonate or borax solution, grind up the mixture till homogeneous, and then spread a film.

(*c*) Spread a small quantity of sputum on the first glass until it begins to dry in patches, and then invert the second cover-glass.

4. Allow the cover-slips to dry at a temperature not exceeding 45° C., and protect them from dust by placing

them—film surface downwards—in a watch-glass.   Burn the blotting-paper.

5. When dry, fix the films by passing the cover-slips—film upwards—rapidly three times through a spirit-flame.

6. Float the films—surface downwards—on a carbol-fuchsin solution (Neelsen's stain) for two to five minutes. The solution should be previously warmed, but should not be allowed to boil.

7. Remove the films and wash rapidly in water.

8. Decolourize in 25 per cent. hydrochloric acid, dipping the films in the acid just long enough to remove the red colour.

9. Wash at once in 60 to 70 per cent. alcohol, until no further red colour is discharged.

10. Wash well in water.

11. Counterstain in Löffler's methylene blue solution for thirty seconds to one minute.

12. Wash in water, dry (with blotting-paper and in the air), and mount in Canada balsam.

B. Indirect Method.

1. Place 100 c.c. of 5 per cent. carbolic acid in a flask and add 10 c.c. of sputum.

2. Shake until the sputum is disintegrated.   Pour the mixture into a conical glass, and allow it to settle for twenty-four hours.

3. Remove the lowest layers with a pipette, and prepare films as in the *Direct Method*, allowing them to dry, and fixing them in the flame.

4. Wash for three minutes in a mixture of equal parts of alcohol and ether.

5. Dry by blotting, pass three times through the flame, and proceed as in the *Direct Method*, commencing at Operation 6.

OTHER ACID-FAST BACILLI WHICH MAY BE CONFUSED WITH TUBERCLE BACILLI

There are a number of micro-organisms which closely resemble the tubercle bacillus. The best known of these are the *Timothy Grass bacillus* and the *Butter bacilli* of Korn, Tobler, Rabinowitsch and others. They are widely distributed. Other members of the same group have been found in the dung of various animals, more especially mules, in butter and milk, and even in the nasal secretion of healthy persons. These micro-organisms have the same morphological and staining properties as the tubercle bacillus, and some of them produce, on inoculation into guinea-pigs, changes which are indistinguishable from true tuberculosis. They can, however, be readily differentiated from Koch's bacilli on cultivation, as they grow more rapidly and at a lower temperature. Smegma bacilli can readily be distinguished, as they are decolourized when washed in alcohol after they have been stained in carbol fuchsin.

APPENDIX II

OPSONINS

METHOD FOR DETERMINING THE OPSONIC INDEX OF A TUBERCULOUS PATIENT

Required—(*a*) EMULSION OF TUBERCLE BACILLI.

        (*b*) PATIENT'S SERUM.

        (*c*) HEALTHY SERUM.

        (*d*) WASHED CORPUSCLES.

(*a*) PREPARATION OF EMULSION OF TUBERCLE BACILLI.

    (i.) Triturate in an agate mortar for half an hour some moist tubercle bacilli* in a 1·5 per cent. salt solution until thoroughly emulsified; transfer this emulsion to a glass tube, put in a dozen or so sterile glass beads, draw out tube in flame, and when quite cool, seal.

    (ii.) Boil this tube for one hour on three consecutive days, and shake at intervals. This constitutes 'stock emulsion.'

* Moist tubercle bacilli can be purchased from Messrs. Allen and Hanbury.

(iii.) Allow contents of tube to settle, pipette off some of the supernatant fluid into a sterile tube and seal.

(iv.) A small quantity of the contents of this tube, diluted if necessary with 1·5 per cent. saline, form the emulsion used. It should be faintly opalescent. The exact degree of dilution can only be acquired by practice.

(v.) This emulsion should yield roughly three to five organisms per cell.

(*b*) COLLECTION OF PATIENT'S SERUM.

(i.) Prick the finger at root of nail, and withdraw two or three large drops of blood in a Delépine tube of suitable size.

(ii.) Allow blood to clot.

(iii.) Centrifugalize. The supernatant clear serum is now ready for use.

(*c*) COLLECTION OF HEALTHY SERUM.

Proceed precisely as directed in (*b*) *supra*.

(*d*) PREPARATION OF WASHED CORPUSCLES.

(i.) Bleed several large drops of blood into a glass tube containing 1·5 per cent. citrate of soda in normal saline.

(ii.) Centrifugalize. Pipette off supernatant fluid. Add saline solution (·85 per cent.).

(iii.) Shake well, and recentrifugalize.

(iv.) Pipette off supernatant fluid = *washed corpuscles*.

N.B.—Washed corpuscles which have been prepared more than four hours should not be employed.

METHOD.

1. With the glass pipettes make the following mixtures:

(α)	(β)
(*a*) Tubercle emulsion - 1 part.	(*a*) Tubercle emulsion - 1 part.
(*c*) Healthy serum - 1 part.	(*b*) Patient's serum - 1 part.
(*d*) Washed corpuscles - 1 part.	(*d*) Washed corpuscles - 1 part.
Mix well.	*Mix well.*

2. Incubate the tubes containing α and β in an opsoniser at 37° C. for fifteen minutes by the watch.

3. Make films on clean slides* from α and β. Dry.

4. Fix with a saturated solution of $HgCl_2$.

5. Wash in distilled water.

6. Stain both films with hot carbol fuchsin two minutes. Wash in water. Decolourize in 2 per cent. sulphuric acid. Rinse in water, and then wash in 4 per cent. acetic acid to remove hæmoglobin.

7. Stain in alkaline methylene blue† for one minute. Wash, dry, mount.

8. Count the bacterial contents of fifty consecutive polymorphonuclear leucocytes in each film as follows:

Film from Healthy Man.	*Film from Tuberculous Patient.*
Total cells counted - - = 50	Total cells counted - - = 50
Total number of tubercle bacilli present in 50 consecutive cells - - = 97	Total number of tubercle bacilli present in 50 consecutive cells - - = 166

Opsonic Index therefore $= \frac{166}{97}$, *i.e.*, 1·71.

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* The slides should be scrupulously cleansed thus:
- (i.) Wipe thoroughly with clean linen cloth.
- (ii.) Rub surface on which film is to be spread with finest emery paper.
- (iii.) Heat treated surface of slide in flame and cool before use.

† Methylene blue (Grubler) ·5 gramme.
Sodium bicarbonate ... ·5 gramme.
Distilled water ... 100 c.c.

APPENDIX III

DISINFECTION BY MEANS OF FORMALDE-HYDE

KENWOOD, in 1897, published the following conclusions at the Leeds Sanitary Congress:

1. Simple evaporation of solutions of formic aldehyde is inefficient when tested bacteriologically, as a large proportion of gas is polymerized into trioxymethylene, which gives off aldehyde very slowly.

2. Trillat's autoclave is the best of all methods for disinfecting a room by means of formic aldehyde. A 40 per cent. solution of formic aldehyde is heated under pressure in an autoclave provided with a thermometer and a pressure gauge, and a little chloride of calcium is placed in the solution. Practically all the aldehyde is given off before the water comes off as steam, as the boiling-point of the calcium chloride solution is well above 100° C., while the gas comes off below the temperature.

The drawbacks to this apparatus are its weight and cost—£18—and the attention it requires.

The cost of disinfecting an ordinary room, apart from

the cost of apparatus, is about half a crown, as one and a half tubes of formalin are required for 3,000 cubic feet of space.

3. Velvet, cloth, bronze, gilt, silk, etc., are not damaged by formaldehyde in any form. The vapour, on the other hand, will not penetrate bulky articles, such as carpets and the like.

Novy and Waite in 1898 gave the following practical directions:

1. All cracks or openings in the plaster, or in the floor, or about the door or windows, should be corked tight with cotton or with strips of cloth.

2. The linen, quilts, blankets, carpets, etc., should be stretched out on a line in order to expose as large a surface to the disinfectant as possible; they should not be thrown into a heap. Books should be suspended by their covers, so that the pages fall open and are freely exposed.

3. The walls and floor of the room and the articles contained in it should be thoroughly sprayed with water. If masses of sputum have collected on the floor, they should be soaked with water and loosened. No vessel containing water, however, should be allowed to remain in the room.

4. One hundred and fifty cubic centimetres (5 ounces) of the commercial 40 per cent. solution of formalin for each 1,000 cubic feet of space should be placed in the distilling apparatus, and be distilled as rapidly as possible. The keyhole and spaces about the door should then be packed with cotton or cloth.

5. The room thus treated should remain closed for at least ten hours. If there is much leakage or gas into the surrounding rooms, a second or third distillation of formic aldehyde, at an interval of two or three hours, should be made.

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THE END

OPINIONS OF THE PRESS

'WE commend Dr. Latham's book as a most valuable compendium of modern knowledge on the subject, which should be in the hands of all those who may be charged with the control of institutions for the treatment of tuberculous diseases.'—*British Medical Journal.*

'One of the most reliable manuals of the open-air treatment of phthisis as practised in the best sanatoria or as adapted to the requirements of a single patient in a private house.'—*Hospital.*

'It is a practical book written by an author of great experience on the subject, and it has met with the appreciation it deserves.

'The principles and details of open-air treatment as carried out in a sanatorium and in a private house are fully explained and discussed, and chapters on every form of treatment and on the treatment of special symptoms make up a book replete with sound common - sense and useful information.' — *West London Medical Journal.*

'The book deals mainly with diagnosis and treatment, and we can strongly recommend it to all who have a practical interest in the treatment of phthisis.'—*Glasgow Medical Journal.*

'The author has a pleasing and simple style, and the chapters dealing with the various forms of pulmonary phthisis are excellent, while the points given for differential diagnosis are exceedingly clear and helpful.'—*Edinburgh Medical Journal.*

'A few additions have been made to this valuable book and a number of the sections amplified to bring the present edition quite up to date. We have nothing further to add to our hearty commendation of the first edition.'—*Manchester Medical Chronicle.*

'This book will be found most interesting and useful to all who desire the latest and fullest views on both diagnosis and treatment.'—*Canadian Journal of Medicine.*

'The name of the author of this work is a guarantee that it is well done. Dr. Latham's teaching is pleasing and minute, and the

book is a compendium of the best that is known of the treatment of consumption. It should be owned by every physician who has been called upon to deal with this disease, and if patients are bound to have a book, they could not have a better one. The treatment, public and private, indoors and out of doors, appears to us to be correct, and the tone of the book is hopeful.'—*Montreal Medical Journal.*

'This book is one which we confidently recommend both to the general practitioner and the specialist in pulmonary complaints. The chapter dealing with the open-air method as carried out in a private house will be appreciated especially by practitioners in Australia, where well-equipped private sanatoria under the direct supervision of resident medical men are almost unknown, and we are compelled to treat most of our well-to-do patients in a private house. Details of this plan are fully and clearly set forth in this book, which has a good index.'—*Australian Medical Gazette.*

'The book is one well worth studying, and in a very convenient form gives a good, clear, and practical account of modern views on the treatment of consumption. We recommend this valuable and practical book to all our readers.'—*Indian Medical Gazette.*

'It is a well-got-up work by the author of the prize essay on the erection of the King's Sanatorium, is an admirable résumé of our present knowledge of the subject, and everything has been brought absolutely up to date. The style is concise, but at the same time clear and lucid. Very little is said about pathology or morbid anatomy, the subject of the book being mainly diagnosis and treatment, and the theory, as carried out, is discussed in a way that calls for the highest commendation, and bears throughout the impress of abundant clinical observation. Singularly full and practical are the chapters on the avoidance of reinfection and the principles of the open-air treatment in sanatoria, and on the details of open-air treatment as carried out in a private home. This last chapter, in particular, is replete from end to end with valuable advice, and we do not know of any book in which it is dealt with so fully. Now that a good deal of interest is being locally excited in a disease which is becoming all too evident in South Africa, and sanatoria are being contemplated in several localities, every practitioner should have a good up-to-date knowledge of the subject, and we know of no book so good as this. The task of laying down a régime for patients at their own homes confronts all of us continually, and here the practitioner will find all he wants. It is seldom that we can recommend a book with such entire confidence as this one.'—*South African Medical Record.*